PUBLIC DOCUMENT. . . . . . No. 34.

TWENTY-FIRST ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
1890.

MEMBERS OF THE BOARD.

1889–90.

HENRY P. WALCOTT, M.D., *Chairman*, . .	OF CAMBRIDGE.
FRANK W. DRAPER, M.D., ...	OF BOSTON.
HIRAM F. MILLS, C.E., ...	OF LAWRENCE.
ELIJAH U. JONES, M.D., ...	OF TAUNTON.
JULIUS H. APPLETON, ...	OF SPRINGFIELD.
THORNTON K. LOTHROP, ...	OF BEVERLY.
JOSEPH W. HASTINGS, M.D., ...	OF WARREN.

Secretary.

SAMUEL W. ABBOTT, M.D.

Chief Engineer.

FREDERIC P. STEARNS.

CONTENTS.

GENERAL REPORT.

The following report of the State Board of Health comprises the general work of the Board for the year ending Sept. 30, 1889, as provided by the Act of 1886 creating the Board.

Three special reports are also included in this volume which were authorized by the provisions of Chapter 375 of the Acts of 1888, Chapter 289 of the Acts of 1884 and Chapter 84 of the Resolves of 1888 (report upon the pollution of ice supplies). These have also been previously transmitted to the Legislature as Senate Document 4, Senate Document 58 and House Document 545.

The general arrangement of the report is as follows: —

General Work of the Board.

Report of the Transactions of the Board under the Provisions of Section 3 of Chapter 375 of the Acts of 1888. (An Act to protect the purity of inland waters, and to require consultation with the State Board of Health regarding the establishment of systems of water supply, drainage, and sewerage.)

Report upon Food and Drug Inspection, required by Chapter 289 of the Acts of 1884.

Report upon the Pollution of Ice Supplies, required by Chapter 84 of the Resolves of 1888.

Summary of Weekly Mortality Reports of Cities and Towns.

Intermittent Fever in Massachusetts.

The Physique of Women in Massachusetts.

The Influenza Epidemic of 1889–90.

Health of Cities and Towns.

The following members comprised the Board during the year 1889: —

HENRY P. WALCOTT, *Chairman.*

ELIJAH U. JONES,	FRANK W. DRAPER,
JULIUS H. APPLETON,	HIRAM F. MILLS,
THORNTON K. LOTHROP,	JOSEPH W. HASTINGS.

The term of office of FRANK W. DRAPER expired in June, 1889, and he was reappointed for the term of seven years.

THEODORE C. BATES having resigned as a member of the Board, Dr. JOSEPH W. HASTINGS was appointed to fill the vacancy.

At the annual meeting held in June, 1889, the following officers were chosen: —

Chairman, ... HENRY P. WALCOTT.
Secretary, ... SAMUEL W. ABBOTT.

Under the provisions of Chapter 375 of the Acts of 1888, FREDERIC P. STEARNS was reappointed as the Engineer of the Board, and JOSEPH P. DAVIS as its Consulting Engineer.

The following standing committees were chosen at the same meeting: —

Water Supply and Sewerage. — Messrs. MILLS, WALCOTT, LOTHROP, JONES and DRAPER.

Finance. — Messrs. APPLETON and HASTINGS.

Publications. — Messrs. WALCOTT, APPLETON and DRAPER.

Public Institutions. — Messrs. WALCOTT, MILLS and JONES.

Food and Drugs. — Messrs. WALCOTT, JONES and DRAPER.

Legislation and Legal Proceedings. — Messrs. LOTHROP and APPLETON.

Health of Towns and Correspondence with Local Boards of Health. — Messrs. DRAPER and MILLS.

Contagious Diseases. — Messrs JONES, WALCOTT and DRAPER.

Registration of Vital Statistics. — Messrs. DRAPER, WALCOTT and JONES.

Water Supply and Sewerage.

The operations of the Board under the provisions of Chapter 375 of the Acts of 1888, entitled "An Act to protect the purity of inland waters, and to require consultation with the State Board of Health regarding the establishment of systems of water supply, drainage and sewerage," have formed a very large share of the official work of the Board during the year. That portion of the work which comprises the advice of the Board to cities and towns, under the provisions of section 3 of this act, has already been reported to the Legislature in Senate Document 4 (also presented in this report, pp. 1–70).

The examinations of water supplies which have been carried on continuously since June, 1887, will be reported upon in the special volumes now in press and authorized by Chapter 80 of the Resolves of 1889. These volumes will also contain the results of the experiments upon the filtration of sewage which have been conducted at the Experiment Station at Lawrence by Hiram F. Mills, C.E., a member of the Board, together with the conclusions of the engineers, chemists and other experts in these important departments of the work of the Board. The chemical examinations of the waters have been made at the Institute of Technology under the direction of Prof. T. M. Drown, assisted by a well-trained corps of chemists. The bacteriological work has been conducted during the past year under the charge of Prof. William T. Sedgwick of the Institute of Technology. The microscopical examinations of water for organisms other than bacteria were conducted by Mr. G. H. Parker of Harvard University until June, 1889. Mr. Allen Hazen has had charge of the chemical examinations of sewage and sewage effluents at the laboratory at Lawrence.

The report of the Board upon the disposal of the sewage of the Mystic and Charles River valleys (Senate Document No. 2, 1889), was made to the General Court at the beginning of the session of 1889; and under the act of that year a commission was appointed to carry into effect this important undertaking. In compliance with the provisions of Chapter 439, Section 11, of the Acts of 1889, "the books,

maps, plans, engineers' reports, instruments and other property acquired during the surveys and investigations relating to the systems of sewage disposal for the Mystic and Charles River valleys" were transferred and delivered to the newly appointed Metropolitan Sewerage Commissioners.

The importance of the comprehensive acts of 1886 and 1888 concerning the protection of the purity of inland waters cannot be overestimated. In a State so densely populated as Massachusetts many communities are situated in such close proximity that the questions of water supply and sewerage assume very great importance when considered with reference to the mutual interests of neighboring municipalities. With reference to the question of water supply, if the population were equally distributed, the sources of supply would be abundant; but the tendency to aggregation of the population in cities and large towns, especially in the eastern portion of the State, makes the selection of a water supply of good quality and of sufficient quantity a work of no little difficulty. Since the enactment of the statute in June, 1886, 105 municipalities, corporations, individuals and public institutions have applied to the Board for its advice under the provisions of this act.

Food and Drug Inspection.

The operations of the Board during the year, under the provisions of the statutes relative to food and drug inspection, have been conducted as in former years, special attention having been given to such articles as required attention from their unusual liability to adulteration. During the six years or more in which this work has been conducted as a part of the prescribed duties of the Board, 29,686 samples of food have been inspected and examined by the analysts of the Board, by far the greater number of which were submitted to chemical analysis or to such careful microscopic examination as the character of the articles required. The number of the prosecutions conducted during the year for violation of the food and drug acts, and the expenses of administration, have been reported upon in a special document (Senate Document 58), a summary of which is also presented in this report (page 104).

In order to carry out fully the provisions of the statutes, which require that the principal portion of the annual appropriation shall be expended in the enforcement of the laws relative to milk and milk products, a larger appropriation is necessary. The tendency to fraud which exists in most densely settled communities in the sale of milk as well as of butter increases with the rapid increase of population; and, while great care has been taken to give to these articles their proper share of attention, the work in this direction has been limited by the appropriation. The expenditures include the cost of chemical and microscopic analysis, travelling expenses, purchase of samples of food and drugs, and the pay of inspectors. For such efficient work as the statutes require, an additional appropriation of $1,500 should be made.

Infectious Diseases.

During the year 1889 the Board has been requested in several instances, by local boards of health, to make investigations relative to the prevalence of infectious diseases, of which the following constituted the principal cases.

Small-pox.

No serious epidemic of this disease has made its appearance in the State since the general epidemic of 1872 and 1873, in which years the deaths amounted to 71 and 46 per 100,000 of the living population. In no year since 1873 have the deaths amounted to more than 3 per 100,000.

The entire number of cases which were reported to the Board as having occurred in the State in 1889 was 15, or less than half the number reported in the previous year.

Ten, or two-thirds of this number, occurred in Boston in October and November. The remainder occurred in the first half of the year. Two were paper-mill operatives at Holyoke, employed in the operations of rag dusting and rag cutting.

In one case only during the year was the Board requested to make an investigation. The circumstances were as follows.

A case of small-pox was reported from the town of Lanesborough May 17, 1889, by telegram, and the State Board was requested to investigate the same. The secretary went up the same evening, arriving at Lanesborough at 8.45 the next morning, and found the following history of the case.

The Belgian steamer "Westernland" sailed from Antwerp on the 27th of April, having on board 121 cabin and 1,002 steerage passengers, and arrived at New York May 8. The mercantile reports state that she was "detained at quarantine with a case of small-pox on board, a child in the steerage." Among the steerage passengers were parts of two families who came from the neighborhood of Charleroi, the heads of the two families having been employed for some time at the Berkshire glass works in the town of Lanesborough. Shortly after the day of sailing, a case of small-pox made its appearance on board the steamer in the person of one of the numerous crowd of steerage passengers. The appearance of the results of vaccination in one of the families who arrived at Lanesborough would indicate that vaccinations had been practised during the voyage, and also that a few vaccinations had been made shortly before the date of sailing.

At the Berkshire glass works in the east part of the town of Lanesborough are employed about 110 men. There is quite a village of tenement houses about these works, chiefly occupied by the families of the workmen, most of whom are of foreign birth. Mrs. ——, aged 33, was one of the immigrants who arrived at Berkshire village (May 10) from New York. She was taken ill about the time of her arrival in Lanesborough. As soon as the disease was manifest, the whole family were removed from the house which they had occupied, this house being located among other similar cottages in the immediate neighborhood of the glass works, and were isolated in tents in a pasture at a considerable distance from the village. The woman had not been successfully vaccinated since infancy. An imperfect, not typical, scar could be seen upon her arm among the numerous variolous pustules which had made their appearance. The disease was not confluent, the pustules being on an average about one-half inch apart over the whole body. At

the time of visit (9.30 A.M., May 18) she appeared comfortable, was in good spirits and conversed readily. She became delirious on the same day and died at 2 P.M.

The public schools in the village, two in number, had become much demoralized, and were closed by the town authorities after nearly all of the scholars had left school. Vaccination was quite generally practised among the operatives and school children, and no other cases occurred in the town.

Record of Cases of Small-pox reported to the State Board of Health in Massachusetts, 1889.

Number.	Place of Occurrence.	Date of Report.	Nationality.	Age.	Sex.	Deaths.	Occupation.	Previously Vaccinated.	Number of Scars.
1	North Adams,	Jan. 14,	United States,	29 yrs.	F.	-	Housewife,[2] .	Yes.[1]	3
2	Northboro', .	Mar. 26,	United States,	32 "	M.	-	In satinet factory.	Yes.[3]	2
3	Holyoke, .	Apr. 15,	United States,	22 "	M.	-	Duster, paper mill.	Yes.[4]	1
4	Holyoke, .	Apr. 29,	Ireland, . .	22 "	F.	-	Paper mill, .	Yes.[5]	1
5	Lanesboro', .	May 16,	Belgium, .	33 "	F.	1	Housewife, .	Yes.[6]	1[7]
6	Boston, . .	Oct. 17,	Italy, . .	12 "	F.	-	School girl, .	Yes.[6]	2
7	Boston, . .	Oct. 17,	Italy, . .	50 "	M.	-	Laborer, . .	Yes.[6]	2
8	Boston, . .	Oct. 17,	Italy, . .	14 "	M.	-	Cabinet maker,	Yes.[6]	2
9	Boston, . .	Oct. 17,	Italy, . .	21 "	F.	-	Housewife, .	Yes.[6]	2
10	Boston, . .	Oct. 17,	Italy, . .	18 "	F.	-	School girl, .	Yes.[6]	2
11	Boston, . .	Oct. 17,	Italy, . .	20 "	M.	1	Cabinet maker,	?	-
12	Boston, . .	Oct. 23,	British Prov.,	20 "	M.	-	- -	No.	-
13	Boston, . .	Nov. 4,	United States,	7 "	M.	-	- -	No.	-
14[8]	Boston, . .	Nov. 18,	United States,	11 "	M.	-	- -	Yes.	1
15	Boston, . .	Nov. 20,	United States,	6 mos.	F.	1	- -	No.	-

[1] Six years since.
[2] Husband worked in printing room of print works.
[3] Two years and six months previous.
[4] Fifteen years previous.
[5] In childhood.
[6] In infancy.
[7] Imperfect scar.
[8] Contracted from No. 13.

Small-pox in Other States and Provinces.

In compliance with the interstate resolutions adopted at Toronto in 1886, being a mutual agreement to report certain infectious diseases, the following notices have been sent to the State Board of Health during the year 1889: —

Small-pox. — From Pennsylvania: 10 cases reported in January and 5 in May. Ohio: 12 cases in January and 1 in December. Minnesota: 1 case in January, 3 in July, 1 in August, 1 in November and 1 in December. Maine: 1 case in March. Ontario: several in March, 1 in May, 4 in October and 1 in December. Quebec: 3 in April. Connecticut: 1 in May and 2 in December. Michigan: 2 in May and 3 in December. Illinois: 2 in June and 1 in November. Tennessee: 2 in September.

Yellow Fever. — From Louisiana: 1 case reported in October.

Diphtheria.

So far as can be learned from the voluntary returns made to the Board during the past year, diphtheria has prevailed to an unusual degree; and in several instances the Board has been called upon, chiefly by local boards of health, to investigate its prevalence, under the provisions of section 3 of chapter 80 of the Public Statutes.

Diphtheria spares no part of the State in its prevalence. In the registration report of 1880, Dr. C. F. Folsom showed that, out of a total of 341 cities and towns, diphtheria had appeared in all of them except 12 during the years 1871–80, and had caused the death of one person or more in each town; the total number of deaths from this cause during that period being 18,714, two-thirds of whom were under five years of age.

Leverett. Late in April the Board was requested to investigate certain cases of diphtheria which occurred in the town of Leverett in Franklin County. It had been openly charged that the selectmen, acting as a board of health, had not taken proper precautions for the prevention of the spread of the disease. An agent of the Board was sent to Leverett, who reported the following facts. The cases, all of which had occurred within a month past, and were four or five only in number, were confined to the Pratt family or families. A woman living with them went to Enfield with her boy, a lad of nine years; while there the boy was taken ill and died, about March 27, 1889. The cause of death, as certified by

the attending physician, was pneumonia, although it was afterward learned that the child had a sore throat with swelling. The body of the child was at first placed in a tomb, and afterward brought by consent of the physician to the town of Shutesbury, at a short distance from the north-east part of Leverett, on March 28. The Pratt families were present at the time of the burial of the boy. The coffin was opened in the open air. On the same day the boy's mother was taken ill with diphtheria. On April 29 the selectmen placed a red flag, as a warning, at the junction of the road leading to the infected house with the main road, and another at the house, and notified the family where the illness occurred to remain in quarantine. Children from the infected house were not allowed to attend school.

This house, so far as the possibility of isolation was concerned, was favorably located, in a sparsely settled part of the town, at the top of a hill and remote from other houses. The sanitary conditions were not particularly unfavorable. The well was above the house and barn, and the privy vault below the house and on the opposite side from the well.

Of the boys who were present when the coffin was opened, the first was taken ill about April 5 or 6, and was seen by a physician on the 8th of April; the next one was taken ill April 9. A married daughter was taken ill during the same week, and died in three or four days. The older brother, aged 17, died; making in all three deaths. The number of cases which occurred in this immediate neighborhood, if the boy reported as having died of pneumonia and brought from Enfield be included in the number, was eight or nine.

The conclusions as to the cause of the spread of the disease in these cases point very strongly to a history of direct communication, with probability that the lad who died at Enfield and was brought to Leverett for burial was a victim of diphtheria, which was known to have prevailed in Enfield during the months immediately preceding his illness.

The examination of the conditions under which diphtheria prevails within the limits of any district presents certain difficulties consequent upon the changeable character of the population, and in cities upon the density of the population.

This element of density or proximity makes it especially difficult to trace the lines of communication which apparently constitute one of the important factors in the etiology of diphtheria.

Sandisfield. It was for this reason that the continuous existence of the disease in the town of Sandisfield in Berkshire County, in 1888 and in 1889, presented peculiar advantages for examining the conditions of prevalence of the disease.

Sandisfield is a small farming town of about 1,100 inhabitants (1,107 by census of 1880), and has a diminishing population. As compared with other towns of the State it is unusually inaccessible by the ordinary routes of railroad communication. It lies mainly along the upper valley of the Farmington River and upon its western water-shed. It is interspersed with high hills and deep valleys along the tributaries of this river. The distance of the town to either of three railroads, north, west and south, is about eighteen miles, the nearest points being Chester and Great Barrington in Massachusetts and Winsted in Connecticut.

During the period of ten years ending with 1880, embraced in the report of Dr. Folsom, there had been but two deaths from diphtheria in Sandisfield; and hence this town held a comparatively low rank in the list of towns presented in that report (being the 309th out of a list of 341 towns), the annual mortality ratio per thousand from this disease being but .17. During the next seven years (1881-1887) there were three more deaths from this cause, one in 1881 and two in 1883. None were reported in 1884, 1885, 1886 and 1887.

In the summer of 1888 (in June) a school teacher whose home was in Sandisfield, at the village of New Boston, came home from the town of Agawam in Hampden County, where she had been teaching, and was taken ill on the day after reaching her home. Her illness was pronounced by a physician to be diphtheria. The patient was not very sick, and went about the house, not confined to bed or to one room. The diagnosis was discredited, and no disinfection was practised after her illness. Eleven days later, June 14, her

niece, aged 7, living near by, was taken ill and was brought to the house where the aunt lived, to be cared for. The mother of this child went to and fro frequently between the two houses. It was claimed that disinfection (fumigation) was practised in the house where the aunt lived, but not in the house where the child lived and was first taken ill. Milk was said to have been supplied from the former house to the family of the attending physician, who lived on the opposite side of the street, and also to other families. The father of the child took the remainder of his family away to the adjoining town of Colebrook River in Connecticut, through fear of the disease.

The third case was that of a boy who lived at Montville, about three or four miles up the river. No connection could be traced between this case and the preceding, except that the boy attended the same Sunday school with the former family.

Three cases were next reported in the family of the physician already mentioned, the first being taken ill August 19, the second on August 29 and the third September 3. Two of these cases were the children of the physician, both of whom died; the first being reported as a death from diphtheria and the second from croup. Attempts were made at disinfection, and not long afterward the physician sold his property and left the town, the house being vacant till May, 1889. Before it was reoccupied, the house was repapered, whitewashed, and a quantity of sulphur was burned in it.

In October, 1888, the mother of the second case mentioned above visited Springfield and Agawam, and, on the third day after leaving her home, she was taken ill with sore throat (not pronounced to be diphtheria by her physician). After a few days she returned home, and was said to have died from croup in two days after her return. Four of this family were taken ill from diphtheria, three being reported October 14 and one October 17. Two of these (children) died at the first house mentioned, after which this house was imperfectly disinfected.

Four more of the relatives of this family were taken ill, December 11, 12, 17 and 21, and were taken to the first house to be cared for.

The agent of the Board, who visited the town in November, 1889, describes the foregoing as a six months' reign of diphtheria in one family. The house of the younger family was not occupied after the cases last referred to had recovered.

About the middle of December (cases reported Dec. 14 and 17, 1888) four cases of diphtheria occurred in the family of the village postmaster, who also kept a country grocery store. A young child was first taken ill; December 17 the father was taken ill and soon died. Frequent communication between this family and the former families was more than probable. The central position of the country post-office and grocery made such communication easy. This family left the town, and no further history could be had.

On January 17, 1889, another case occurred in the person of a school girl of 9 years. Further particulars of this case are wanting.

January 27, the young child, and afterward the wife, of a blacksmith were taken ill. Both of these persons had been present at a dance at Christmas, while the disease was prevailing in other families, and one of the members of one of the infected families called at the house of the blacksmith about the same time.

February 9 a case was reported in a family living in the northerly part of the town near Colebrook River. This child died, and four others were soon taken ill in the same family. These cases were attended by physicians from Connecticut, a portion of whom did not deem it essential to report their cases to the local board of health of Sandisfield.

No further cases occurred in the town until October. The disease also was more or less prevalent during the year in the neighboring town of Tolland in Massachusetts and in Colebrook River in Connecticut.

In May, 1889, a physician came to town and settled in the house left vacant by the former physician, and in which diphtheria had existed. About the last of September he attended cases of diphtheria in Colebrook River. October 12 a boy in his family, aged 11, was taken ill; and on the

19th two more members of his family (sisters, aged 15 and 17) were taken ill. Meanwhile a patient of the same physician was confined October 12, and on the 14th her son, a lad of 9 years, was taken ill. This boy attended school in the southerly part of the town, where children were present from families in which diphtheria had prevailed. The mother was taken ill on the 18th, and the nurse, aged 60, on the 23d. There were three different avenues of infection by either of which this family may have become infected with diphtheria: 1, by the public school; 2, by the attending physician; 3, by the nurse, who was known to have been ill with diphtheria before she went to this family.

November 1 a servant in a family living on the bank of the river, a short distance from one of the last named cases, was taken ill. She had called at the house of the latter during their illness. November 2 a child in the same family, and November 4 another child, was taken ill. The latter died.

In Colebrook River, October 22 and 24, two children were taken ill who attended the same school with the children in the last-named families.

October 22 another case occurred at New Boston in the person of a man, aged 27, in which case no special connection was traceable.

The sanitary surroundings of the house in which the first case occurred were very defective in some particulars. It stood at the foot of a hill at the side of the village street. Ten years previous to this invasion of diphtheria there had been two fatal cases of typhoid fever in it, according to the statement of a physician who then lived in the town. The wooden sink drain, about twenty feet in length, discharged its contents upon a manure heap in the hog pen at the back of the house. The ground about the back of the house was damp. The water supply was from a spring high up upon the hill-side and away from contaminating causes. The water gave the following result upon analysis: —

WATER ANALYSIS.

[Parts in 100,000.]

Appearance.			Odor.	Residue.			Ammonia.		Chlorine.	Nitrogen as	
Turbidity.	Sediment.	Color.		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid.		Nitrates.	Nitrites.
None.	Very slight.	0.2	None.	3.00	0.85	2.15	.0006	.0058	.12	.0050	.0000

and is a very good water for domestic use. The discharge from this spring keeps the ground in the rear of the house constantly saturated and damp. There was no evidence that the water supply could be chargeable with carrying infection. Other houses which were visited had the ordinary features of small farm-houses and village residences, not specially objectionable. One house upon the bank of the river had formerly been a cider mill and was converted into a house. It was open to the air underneath, the mill race running under it. The privy and the well were on opposite sides of the mill race, and in such a location with reference to each other as not to suggest contamination.

In order to trace this outbreak backward still further, the school teacher to whom its introduction into this village was apparently due was visited several months after the last case had occurred, and was questioned as to its source in her own case.

Nothing further could be found, except that she had visited the city of Springfield a short time previous to the time of closing her school in June, 1888, at which time she was taken ill. It was slightly prevalent in Springfield at the time, but not in the neighboring town where she was teaching. To trace its origin further among the mazes of a large city was found to be impossible.

Summary. — The attendant conditions which prevailed in this town during the existence of diphtheria for a year and a half were as follows: first, the probable introduction of the disease in June, 1888, in the person of the school teacher; its spread throughout her own family and those of relatives, and thence to other families in the town, through a period of

seven months or more; abundant modes of infection existing in the village school, the post-office, the grocery, the Sunday school, public entertainments, and too free intercourse from house to house between the well and the infected. After an interval of about eight months, a fresh outbreak took place, possibly in consequence of occupancy of an infected house after imperfect disinfection, and possibly from a fresh importation from a neighboring town. Prompt and thorough isolation at the outset, together with careful and efficient disinfection, undoubtedly might have arrested the progress of the disease, and have limited its spread to the first cases which occurred.

Marlborough. — In the town of Marlborough, having a population of 12,000 to 14,000 inhabitants (10,941 by State census of 1885, diphtheria prevailed during the latter part of 1888, and the spring of 1889. A public water supply was introduced from Lake Williams in 1883.

The town has been visited by several epidemics within the past twenty years. An epidemic of small-pox in 1872–73, one of scarlet fever about three years ago, and of measles two years since, were followed in 1889 by 118 cases of diphtheria, with 21 deaths. These cases are those reported to the Board of Health. It was believed that the actual number of cases occurring was considerably greater, since in some instances only the first cases occurring in families were reported to the local board. One case was reported to the local board in November, 1888, in the person of a child of 6 years living at some distance from the town. The next case reported was that of a child on School Street, April 4, 1889, a pupil, C——, in the Hildreth School, aged 10. It could not be learned, on inquiry of the parents, that the parents of the child had been where diphtheria existed either within or outside of the town, although they had all attended the funeral of a relative at Brookline before the illness of the child. On April 10 another child in the same family, aged 11 years, was taken ill of diphtheria. April 20 a child, O'G——, aged 7, living at a distance on Huntington Avenue, was taken ill. This child did not attend the Hildreth

School, and the only possible or probable connection was the possible meeting at church with other children slightly ill. Two cases, D——, aged 9 and 3 years, were reported on Howe Street, April 22 and 25; another, C——, on Clinton Street, April 24, and two in one family, on Main Street, April 29 and May 7.

Marlborough has three large school-houses, each containing nine rooms or classes averaging from forty to fifty scholars in each room, — the Hildreth, Washington and Bigelow, — besides the High and other schools. Children living remote from these schools walk to school or are brought in at the expense of the town.

April 29 a child, D——, living two miles from town (but who was conveyed from home to school), was taken ill. April 30 a child, P——, attending the Hildreth School, was taken ill; from which time this school appeared in the estimation of the local board of health to have become a focus of infection. No special means appear to have been taken at that time to prevent its spread. May 1 another child, L——, 6 years old, living near the Hildreth School, was taken ill; said to have played with the children attending this school. After this date, May 1, cases appeared quite frequently throughout the remainder of the year. Through the summer months by far the greater number appear to have occurred in the region bounded by Newton, Main and Maple streets, Howe and Neil streets being the principal focus of infection. Later on the disease occurred frequently in other parts of the town. In one instance a wedding appears to have been the occasion of spreading the disease. A child died on Sunday and was buried on Monday. Its mother attended a wedding on Tuesday. A dozen children were taken ill within ten days in families of persons who attended the wedding.

The children who were taken ill with diphtheria in this epidemic were mainly attendants upon the four schools known as the Hildreth, Washington, Bigelow and Pleasant. None of the scholars attending the High School were affected. The Hildreth school-house, at which a very large share of the children attacked were pupils, was built in 1882. All of the nine classes suffered more or less; 49

scholars were taken ill, of whom 7 died. Inquiry at the school showed that there had been more cases of illness from diphtheria than had been reported to the local board of health. It was stated that this school building had been the subject of action under the new statute, on account of want of proper ventilation. There is much wet land in its neighborhood. The privy vaults lay against the walls of the school-house. The doors communicated with the school-house cellar as well as with the out-door air. The closets were quite damp. At the Washington School the boys' privies were offensive to the smell, and the floors were saturated with urine, and needed renewal. The streets upon which the greater portion of the cases occurred were in the immediate neighborhood of the Hildreth School, and a considerable number of remote cases were also those of pupils attending this school.

In some cases five had been ill where one only was reported. Infected houses were generally designated by red flags. Disinfection by sulphur fumigation was quite generally practised, but not thoroughly. In one case the sulphur was placed upon burning coals in the cellar, and the fumes allowed to rise through the house while the family still occupied it. The instructions as to disinfection were generally given by the physicians in charge of cases, and not by the local board of health. But little attention appears to have been given to cases complaining of sore throat in the same houses where diphtheria existed.

In some of the houses in which diphtheria occurred there were wells in the cellars, the water of which was used as the domestic water supply.

The epidemic appeared to have expended its force in the most infected streets, for the reason that the more susceptible part of the population, that is to say, the young children, had nearly all had the disease.

It did not appear that milk had in any case constituted a factor in spreading the disease, although its spread may have been promoted by the immediate passing of milkmen, grocers and other tradesmen from infected to non-infected houses.

In a town in which 200 cases of diphtheria had occurred

among 2,000 children, in the course of eight months, greater care should have been taken in the management of the epidemic. Disinfection should have been effected under the supervision of the local board of health, and not left to the direction either of the attending physician or of the family. A thorough inspection of the school buildings should have been made, with special reference to their sanitary condition. The reporting of all cases should be required by the Board of Health from the attending physicians. A house-to-house inspection would have rendered much aid in tracing sources of infection and suggesting remedies for defects. A noticeable fault in the town was that of allowing drains and cesspools to discharge or overflow into the street gutters. Greater care in the matter of isolation and quarantine and the prevention of the mingling of the attendants upon the sick with the general public, at church, at public entertainments, weddings, etc. Funerals should be strictly private.

North Andover. — Mr. C. R—— lives at a farm-house in Andover, a mile or more from the village. His family consisted of himself, wife and three children aged 6 and 4 years and an infant of 8 months.

The oldest child, who was an attendant at the public school, was first attacked, complaining of illness June 2, and two days afterward the second child was taken ill, the disease in both instances proving to be diphtheria. The second child died in five days. The babe had been sent away to avoid infection, but was taken ill June 11, the disease being pronounced to be membranous croup. It was brought home, and died on June 15. The mother was taken seriously ill on the following day (16th) but recovered, and Mr. R—— suffered slightly with sore throat.

Conditions. — The farm-house is located at the junction of two roads at the foot of a hill, of which the soil is gravel, underlaid with clay. The general level of the farm buildings (barn, cow-house, shed, etc.) is above that of the house, and their location in close proximity to it. The barn is connected with the house by a shed twenty-seven feet long, and its cellar is at a higher level than that of the house. In a recess made by the barn, the shed and the L

of the house are located the privy and a cesspool. In an opposite angle made by the main portion of the house and the shed is the well, used chiefly for drinking purposes, at a distance of not more than twenty-five feet from the cesspool. About ninety feet from the house, toward the foot of the hill, is another well, used for watering the cattle, cooling milk, and to some extent for drinking. The land on the slope of the hill above it is cultivated for garden vegetables. The house cellar extends under the main part of the house only. It is cemented and drained, but not well lighted, and is used for the storage of vegetables and vinegar. The cans of milk are also placed in this cellar, from which they are taken about 12 to 1 A.M. and distributed in Lawrence. The milk collector does not usually see the family.

Mr. R—— visits Lawrence about twice a week. There was no diphtheria elsewhere in North Andover at or immediately previous to these cases, but it had been slightly prevalent in Lawrence throughout the preceding spring months and in May had begun to increase rapidly.

A young woman in a neighboring family had complained of sore throat and had been quite ill at her home in Nova Scotia just previous to the time of her coming to North Andover in the month of May, and these children who were attacked with diptheria had often been in close communication with this young woman.

The water of the two wells was examined with the following result. An analysis of the water of a well believed to be unpolluted and located upon the neighboring hill, on higher ground, is also presented for comparison.

Number.	Date of Collection.	Appearance.			Odor.	Residue on Evaporation.			Ammonia.		Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Bacteria.
		Turbidity.	Sediment.	Color.		Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid.				
	1889.													
1	June 20,	0	0	0	0	7.75	1.20	6.55	.0000	.0012	.23	.1200	.0000	127
2	21,	0	0	0	Faint,	11.35	1.35	10.00	.0148	.0052	1.07	.4500	.0005	3264
3	21,	0	Slight,	0	None,	7.75	.95	6.80	.0018	.0034	.62	.1100	.0000	1150

1. Unpolluted well on top of hill in North Andover.
2. Polluted well at farm-house.
3. Doubtful well at farm-house.

The proprietor of the farm was immediately advised as to the probable pollution of the well near the house, this pollution being undoubtedly due to its close proximity either to the cesspool, privy vault or barn cellar, or to all of these combined, and was also advised to have its use immediately discontinued either for drinking purposes or for the washing of milk cans.

In this case there was opportunity for infection, either indirectly from Lawrence, where diphtheria existed, or more directly from the young woman at a neighboring house, who may have carried infection in her clothing.

The polluted condition of the water supply also suggests itself as a factor in the development of the disease.

Hydrophobia.

During the year 1888 several undoubted cases of hydrophobia among dogs occurred in the State, being the first that had been reported since 1881, and there were two cases of death among human beings from the same disease. (So far as can be learned at the date of writing this report these cases among animals occurred mostly in the eastern counties of the State, — Bristol, Plymouth, Norfolk, Essex and Middlesex.) During the past year there has been an increase in the prevalence of this disease among animals, and as a consequence an increase in the mortality from this cause among human beings. As compared with other diseases, hydrophobia has never had a serious effect upon the mortality of the population, and at no time could the disease be said to have become epidemic, the greatest number of deaths that have ever occurred in the State in one year being 15.

The two deaths from this cause in 1888 occurred in Bristol and Barnstable counties, and apparently it was from the south-eastern part of the State that the disease spread into other counties to the north of them. Further particulars have been obtained as to the case which occurred in Bristol County in 1888, and also others which followed in 1889. One physician in Fall River writes: —

I have seen three cases of hydrophobia within nine months or less; two in consultation and one my own. The first was that of a boy of 7 or 8 years, who was bitten Aug. 6, 1888, and died Sept. 26, 1888, after three days' illness.

I was called to see another case at 6 P.M., Jan. 2, 1889. Patient a man about 6 feet 2 inches in height, weighing at least 225 pounds, aged about 46 years. On examining him I came to the conclusion that he had had a cold and was suffering from a consequent neuralgia, as he complained only of pain in the right arm and back. I was about to prescribe for him when he mentioned incidentally that he could not swallow as well as usual . . . on attempting to swallow, he was seized with a general spasm and the cup was dashed against the wall behind him. On further inquiry he admitted that he had been bitten by a stray dog, the September previous, at the coal-yard. The bite was on the right little finger. He also remembered that the same dog bit one of his horses, which died a few weeks afterward. A consultation was held and the man was removed to the hospital, where he died January 4, at 8 A.M., about thirty-six hours after he was first seen. Spasms continued for several hours before his death, even while he was under the influence of ether. Bits of ice were tolerated in his mouth for a few seconds only. The special points of interest in the case were the fortitude with which the man accepted his fate; the rapidity and severity of the case; the utter futility of treatment, the ether simply palliating the intensity of the spasms; and, finally, his care and anxiety for the lives of others, that the same misfortune might not befall them also.

Another physician, detailing another case which occurred in the same city, says: —

A large dog came into a yard, chasing a cat, and bit a boy upon the chin and mouth and disappeared. This was on the 17th of March, 1889. On Thursday, April 11, the boy complained of headache, but continued at his play. On Sunday morning he was not as well; went out of doors but once, and then for a short time only. On Sunday night, or early Monday morning, he said he could not swallow, and complained that his throat pained him. I saw him about 8.30 A.M. on Monday. His tongue was slightly furred; he was conscious and able to talk; pulse 90; temperature not taken but seemed normal to the touch; complained of frontal headache and pain in the throat, with complete inability to swallow. In the attempt to carry a glass of water to his mouth, he was seized with spasm of the muscles of the face and throat, and

he said, "I can't swallow it." Monday evening: speaking to him or touching him when he was not looking would throw the whole muscular system into spasms, and he would repeat, "Oh! oh!" He could not expectorate, or swallow the mucus in his throat. Tongue furred; pulse 120; temperature slightly elevated. Tuesday morning: he has had no sleep, but was more quiet; said his pain was gone and he should be all right if he could swallow. Pulse 140. Six P.M. Tuesday: much weaker, but conscious and able to speak. Paroxysms not prolonged. No vomiting. He never offered to bite, or to tear his clothes, and the only time he required restraint was from 7 to 8.30 P.M. on Tuesday. There was no frothing at mouth, but fauces were filled with mucus, and from early Monday morning to his death he did not swallow.

During the year 1890 special observations as to the prevalence of this disease will be made, which will be detailed in the next annual report.

Registration of Vital Statistics.

An accurate registration of the births, marriages and deaths is a matter of great importance as a part of the life-history of any community whether great or small. Such registration forms the basis of sanitary work, since it is only through a fairly accurate system of registration that we have definite knowledge relative to the actual results accomplished by such work as shown in its effect upon the life of the population.

Dr. Parkes said of such registration: "The attention now paid to public health is in a large degree owing to the careful collection of the statistics of births and deaths, and of the causes of death, made in England during the last forty years. It may truly be said indeed that not only all Europe, but gradually the entire world, has been influenced by the work of the registrar-general of England. We are now able to determine with some precision the limits of mortality and its causes, and are being led up to the consideration of the causes which bring about a high death-rate."

What is true of England is also true of Massachusetts. Our registration covers a period of forty-eight years, and is an important history of the growth of the population, not only of the State as a whole but also of its sub-divisions, the counties and the cities and towns.

Estimating the population at 2,044,506 in the year 1888, the total number of births was 54,893, the marriages were 19,739 and the deaths 42,097, — or 1,719 more births, 206 more marriages and 1,334 more deaths than those of 1887. The estimated birth-rate for the year was 26.85 per 1,000 of the living population, the marriage-rate (persons married) was 19.31, the death-rate 20.59, and the excess of the birth-rate over the death-rate 6.26 per 1,000.

Births.

The births (54,893) were greater in number than those of any previous year. The still-births (1,943) were also greater than those of any previous year. The greatest number of births (5,032) in any month occurred in August, and the least number (4,010) in April. The ratio of male to female births was 105.4 as compared with 105.2 in the previous year, and 105.7 for the period of thirty-five years ending with 1887.

Marriages.

The number of marriages recorded in 1888 was 19,739, which was 206 greater than that of 1887, while the marriage-rate (persons married to 1,000 living) as compared with the estimated population was 19.31, which was slightly less than that of 1887, but greater than that of the period of thirty-five years ending with 1888. The average age of persons married was 28.9 for males and 25.5 for females, which was very nearly the same as that of 1887 and also of the previous seventeen years.

Deaths.

The number of deaths registered in 1888 was 42,097, which was 1,334 more than that of 1887 and also greater than that of any previous year. This number would represent a death-rate of 20.59 per 1,000 of the estimated living population, which was greater than that of any year since 1875. This increase, together with the increase of the birth-rate, would appear to indicate a greater increase of population than that which is estimated by the usual methods of calculation. The excess of the birth-rate over the death-rate as estimated was 6.26, which was greater than that of any previous year except 1886 since 1877. The death-rate in the urban or manufacturing counties (Suffolk, Middlesex, Essex, Bristol, Hampden and Norfolk) was 22.3, and that of the rural or agricultural group (comprising the remaining counties) was 20.0 as compared with 21.8 and 18.8 in the same groups respectively in the previous year. The difference in the mortality-rate of the

two groups was therefore 2.3 per 1,000 as compared with 3 per 1,000 in 1887. The density of population in these two groups differs greatly, that of the urban group being 442 to the square mile as estimated upon the census of 1885, and that of the remaining group being but 102 to the square mile.

Infant Mortality. — The deaths of children under 5 years were 8,870, which number was greater than that of any previous year. The ratio of deaths under one year to the total deaths (21.07 per cent.) was greater than that of 1887 and also slightly greater than the average of the seventeen years ending with 1888. This method of calculation, however, according to Dr. Billings, does not give so correct results as that of comparing the total number of deaths of children with the number of the living population furnishing such deaths.*

Estimating the children living in the State under 1 year of age as 37,780 in 1888, and those under 5 years of age as 187,741, the death-rate per 1,000 of those living at those age periods was 234.8 per 1,000 for those under 1 year and 71.9 per 1,000 for all under 5 years of age. As compared with the births the deaths under 1 year were 161.6 per 1,000 births, which was greater than that of any previous year since 1882.

Causes of Death.

The number of deaths of which the causes were unknown or of an ill-defined character was 538 out of a total of 42,097, or 1.28 per cent. only of the total number, which was but little greater than that of 1887 (1.22). The average of the ten years (1879–88) was 1.60, and of the ten years (1869–78) 3.75.

Of the whole number of deaths those which are usually classed as *zymotic* numbered 8,042, or 19.1 per cent., which was slightly less than the ratio of the previous year (19.5), and also considerably less than the average of the ten years ending with 1888. There has been a gradual and somewhat uniform decrease in the ratio of this class of diseases from 23.3 per cent. in 1879 to 19.1 per cent. in 1888.

The number of deaths from *constitutional* diseases was 9,167, or 21.8 per cent. of the whole number, which was less than the percentage of any year of the ten-year period (1879–88). As in the zymotic class there has been a gradual and quite uniform decrease in the ratio of this class of diseases from 25 per cent. in 1879 to 21.8 in 1888.

* Cartwright Lectures, November, 1889.

In the class of *local* diseases the total number of deaths was 18,404, or 43.7 per cent. of the whole number, which was 1 per cent. greater than that of 1887 and was also the greatest percentage of any year of the decade (1879–88). There was a gradual increase in the ratio of deaths from this cause from 37.1 in 1879 to 43.7 in 1888. The increase in the percentage of this class of deaths was nearly equal to the combined decrease in the zymotic and constitutional classes.

In the other classes of deaths, the *developmental* and the *violent*, there was but little change from the ratios of previous years; in the former those were 4,280, or 10.2 per cent., and in the latter 1,666, or 4 per cent. of the whole number.

There were eight deaths from small-pox during 1888, as compared with three in 1887, none in 1886, and 19 in 1885. There has been no serious epidemic from this disease since 1872 and 1873, in which years the deaths were respectively 1,029 and 668. Special details with reference to the cases which occurred in 1888 may be found in the twentieth annual report of the Board.

There were 219 deaths from *measles* in 1888, or less than half the number registered from this cause in 1887. The ratio to the living population was 1.1 per 10,000 as compared with an average of 1.3 per 10,000 for the thirty years ending with 1888. There were no deaths from this cause in Barnstable, Dukes, Nantucket and Plymouth counties in 1888.

There were 504 deaths from *scarlet fever* in 1888 as compared with 594 in 1887. As compared with the estimated population the mortality from this cause was 2.5 per 10,000, the average of the thirty years ending with 1888 being 5.6 per 10,000. The mortality from scarlet fever was more uniformly distributed than that of 1887. There were no deaths from this cause in Dukes and Nantucket counties.

There were 1,831 deaths registered from *diphtheria and croup* in 1888 as compared with 1,628 in 1887. The ratio from these combined causes to the estimated living population was 9.0 per 10,000 as compared with 8.1 per 10,000 in 1887, which indicated a considerable increase over the ratios of the preceding five years, notwithstanding the fact that the ratio of deaths from croup alone was the least which had been recorded for thirty years, both as compared with the total number of deaths and with the estimated population. There were no deaths from either cause in Dukes County, and but one in Nantucket, in 1888. Those of Suffolk and Middlesex counties were about 50 per cent. more than those of 1887, while those of Bristol and Worcester were less.

The deaths from *typhoid fever* were 943, or 4.6 per 10,000 of

the population, which was greater than those of any previous years since 1882. Of the whole number 625, or 69.4 per cent., occurred in the last half of the year, and 56.9 per cent. in the months of August, September, October and November. The mortality from this cause in most of the counties was nearly the same as that of 1887, those in which there was an unusual increase being Hampden, Hampshire, Norfolk and Plymouth. The ratio of deaths from this disease to each 10,000 of the population for five census years was as follows for the State: 1865, 13.4; 1870, 9.1; 1875, 6.4; 1880, 4.9; 1885, 3.9.

The deaths from *diarrhœal diseases* in 1888 were as follows: from diarrhœa 587, dysentery 248, cholera infantum 2,195, cholera (morbus) 79, enteritis 670, — the numbers in the case of each disease, except dysentery, being slightly greater than those of 1887.

There were 5,728 deaths registered from *consumption* in 1888. This being the most prominent cause of death. This was 28. per 10,000 of the living population. The actual number was also less than that of either of the preceding years since 1880, while the ratio as compared with the population has steadily decreased since the early years of registration from 42.7 per 10,000 in 1853 to 28. per 10,000 in 1888. The mortality from this cause was greatest in the months of March, April and May.

There were 3,716 deaths from *pneumonia*, much the largest number recorded in any year since the beginning of registration, and indicated a ratio of 18.2 per 10,000 of the living population as compared with 16.6 in 1887. In every county, except Nantucket and Plymouth, the deaths from this cause exceeded those of 1887. The greatest mortality occurred in January, February and March.

The deaths from *whooping-cough* were 245, nearly one-half of which occurred in Suffolk county. There were none from this cause in Dukes and Nantucket counties.

Medical Examiners' Returns.

By a recent statute these returns of sudden, suspicious and violent deaths are included in the registration report. The whole number of such deaths submitted to the medical examiners for investigation during the year was 1,649, of which number 1,261 were males and 373 were females, and 17 were unspecified. The percentage of males was 75.9, which differed but little from those of the three previous years. Of the whole number of deaths investigated by the medical examiners, 52, or 3.14 per cent., were

homicides; 190, or 11.5 per cent., were suicides; 785, or 47.5 per cent., were accidental deaths; and 624, or 37.8 per cent., were from natural and unknown causes, including alcoholism. A summary is presented in the report of cases in which alcoholism or intemperance is mentioned by the medical examiners as being either directly or indirectly concerned in the causation of death. Of such cases there were 5 homicides, 31 suicides, 91 accidental cases and 108 from other causes, — total, 235.

Noxious and Offensive Trades.

Under the provisions of Section 93, of Chapter 80 of the Public Statutes, the State Board of Health is authorized to act upon the applications of parties who make complaint against persons carrying on noxious or offensive trades. One such complaint was made to the Board during the year.

A petition was received on June 25, 1889, from certain citizens of the town of Dighton alleging that "the manufacturing of Paris Green at the Anchor Color Works has become a nuisance, inasmuch that it is killing trees and vegetation in its vicinity, thereby endangering the lives and health of said citizens" and desiring an abatement of the alleged nuisance.

The secretary visited Dighton on June 26. The district in which the petitioners live is limited, about twenty rods of the street running east and west from the Taunton river, across the Old Colony Railroad a few rods south of the depot to the village of Dighton.

A short distance west of the railroad, and about twenty rods south of the road above mentioned, upon a small tidal creek which empties into the river, are located the Anchor Color Works. Among the different products of this establishment is paris green, the manufacture of which has rapidly increased at this place within a few years past, about 200 tons having been made there in 1889. The demand for this article has come mainly from its use in agriculture for the destruction of insect-pests.

The principal structure at the works, in which the paris green is made is a long building with a roof nearly flat, having an extension upon its easterly end. Paris green, the well-known poisonous pigment is made by the combination of

arsenic and sulphate of copper, with the aid of an alkali and acetic acid. The arsenic and the alkali are at first mixed in hot water, the sulphate of copper is added and then the acetic acid. The resulting precipitate is spread upon racks of cloth and dried in a heated apartment, while the supernatant liquid portion is allowed to run off into the creek. After drying, the powder is transferred to a bolting-room, a small apartment in which the powdered pigment is received into barrels. This bolting-room is ventilated by a fan operated by the same engine which moves the bolter; the fan serves two purposes, first, to remove the air charged with the fine powder floating at the mouth of the shaft leading to the bolter, and also to remove the air from the bolting-room, which is also charged with the same poisonous dust, and force the same into a smaller tight compartment, from which it finally escapes into the air by means of a six-inch shaft, leading upward out of the building.

In the early summer of 1889 and while the process of manufacture of paris green was in active operation, it was found that the foliage upon trees and plants on the leeward side of the factory, (the prevailing winds at that time being from the south and south-west,) was destroyed or withered for a distance of 20 to 30 rods from the works, the principal effects being noticed along the street leading east and west above referred to. The trees in question were both shade and fruit trees, some on the south and some on the north side of the road, such as white ash, poplar, arbor vitæ, apple and cherry trees. These trees, together with some grape-vines and small shrubbery had the appearance of being scorched by fire and partially stripped of their foliage. The trees in a lane running south toward the works also had the same appearance. Rose bushes and other plants in the gardens of the houses along the road in this neighborhood showed similar effects. Garden vegetables appeared to withstand the injury better than taller plants.

Potatoes in gardens south of the road, and about 300 feet from the factory, had no bugs upon them and their owners said that potato-bugs had not been seen in their gardens, although no paris green had been used by them to destroy those insects, while they were quite abundant at greater

distances from the works. There did not appear to be any perceptible effects on the foliage east of the railroad, nor in the region across the creek, and south of the factory. A considerable quantity of the paris green had been deposited on the roof of the factory near the shaft leading from the bolting-room, and was very plainly visible as a bright green coating upon the roof of the building.

Some of the employees who worked in this department of the factory presented the peculiar effects of arsenical poisoning in various ways. The special effects noted were conjunctivitis, eruptions on the fingers, hands and fore-arms. Several had their hands bandaged to protect sores, or scratches, and some wore leather gloves. Other parts of the body were found to be liable to eruptions.

Some care was taken to prevent harm to those who were employed, and a room was provided for bathing after finishing work.

The following regulations were posted in several places in the works.

PARIS GREEN.

Men must wash their clothes provided for them. Wash in ammonia water before going to the closets. Wash at least once an hour in ammonia water. Wash every day the entire person in the bath-tub. *Paris green is a poison*, and those working in it must take every precaution against getting it in the nostrils, under the nails, in the ears, or on the body. Any breakage of the skin by nails or jams must be reported at once to the office. — *Anchor Color Works.*

So far as could be learned from inquiry and examination of persons living in the neighborhood of the color works, no symptoms, or traces of symptoms were observed which would indicate poisoning from arsenic. The prevailing feeling among the people near the works appeared to be that of dread of future harm. It was important to ascertain, however, whether the fine powder might not become deposited upon growing vegetables in sufficient quantities to render them unfit for use as food.

Samples of plants growing in the neighborhood of the works were obtained at two points. One lot obtained near the works, at a distance of not more than 20 feet north from

the bolting-room, consisted of grass and equisetum, the other samples consisted of foliage from poplar trees, burdock plants and leaves of corn obtained at a distance of about 15 rods north of the works and south of the street. These were submitted to Dr. Harrington for analysis, who reported arsenic present in "considerable amounts," the former specimens having the larger quantity.

On July 12, the works were again visited and samples collected as follows, the result of Dr. Harrington's analysis also being given: —

No. 1. Soil from a patch of oats growing ten rods north-west of the freight-house, fifty rods north-east of works. No arsenic present.

2. Green oats from same field. No arsenic.

3. Soil from open field seventy feet north of bolting-room of color works. Trace of arsenic present.

4. Equisetum, near the wall, about thirty feet north of bolting-room. Large quantity of arsenic.

5. Sample of water from well, a short distance east of works (Hathaway's). Slight amount of arsenic.

6. Water from brook near Barney's wheelwright shop, north of road, thirty rods distant. No arsenic.

7. Head of lettuce from garden south of stone wall, and about three hundred feet north of works (Andrew's.) Good trace of arsenic.

8. Soil from garden north of works (Hodnett's). Trace of arsenic.

9. Soil from potato patch opposite depot, west of railroad, one hundred rods north-east of works. No arsenic.

10. Leaves of walnut tree near stone wall in field, seventy-five rods north-east of factory, west of railroad. Good trace of arsenic.

At this time July 12, the trees for some distance along the street, north of the works had shed their leaves, so that this portion of the street presented the appearance of October instead of July, except that occasional new shoots were beginning to appear on some of the trees.

As a result of its inquiries, the Board stated that it was important that improvements should be made in the process of manufacture, so as to prevent the escape of the dry pow-

der into the air. Instead of a direct, upright shaft open at the top, a large horizontal wooden shaft was constructed resting upon the top of the factory, with which the upright shaft from the bolting-room opened. Near the opposite end a vertical iron pipe was introduced, which terminated below at the surface of a tank of water. A small steam-pipe also entered the shaft, quite near the upright wooden pipe. At first the wooden shaft was packed with coke for a distance of several feet. It was found on trial that the coke soon became clogged with the paris green, and it became necessary to remove the coke. This arrangement proved satisfactory, since none of the paris green appeared to reach the tank.

The following extracts from communications from the proprietors of the works refer to the changes which were made: —

This arrangement we find entirely prevents the escape of any dust. We have also put double doors to the rooms in which the dust is collected. We are also having our striking tubs placed near each other, and propose to boil in one or two large tubs, where last season some eight or ten tubs were used, thus concentrating our boiling in these large tubs, requiring only a few hours for it, while it required the larger part of the day last season. With these improvements we are satisfied no trouble will arise in the manufacture of this article, and any further changes that may be necessary you can rest assured we shall make to afford ample protection.

It was also stated by them in a later communication, that the men who worked in the green should be provided with clothing for that purpose, and all necessary precautions should be taken to prevent the paris green from leaving the premises.

After the manufacture had been conducted for several weeks under the foregoing modifications, it was thought best to make further inquiries as to the possibility of escape of the noxious powder from the works. And in order to avoid the liability to error in consequence of collecting samples of earth or other material which might have been affected by the poison at an earlier date before the improvements were made, it was deemed best to wait until a snow storm had occurred and collect samples from its surface after several days' manufacture of the paris green. Being

an unusually open winter, no good opportunity presented itself till March 11, when ten samples of snow were collected from different localities in as many different directions from the works. These included surface snow and snow from deeper layers, since there had been one slight snow storm since the date of the last day's manufacture of the paris green. On a later date (April 24) samples of growing herbage were obtained, which, together with the samples of snow, were submitted to analysis, and proved to be practically free from arsenic. Since the latter date no complaints have been received relative to this establishment. It would appear, however, that, in addition to the foregoing precautions, greater care should be taken for the protection of the employees from the noxious effects of the poison than are at present afforded.

Pollution of Ice Supplies.

The Legislature of 1888 directed the State Board of Health to "make a special investigation with reference to the pollution of ponds, lakes, streams, or other bodies of water used as ice-supplies in this state, especially with reference to the effect of such pollution upon the healthfulness of such ice for domestic use." The following winter was unusually mild, and also unfavorable for the collection of samples of ice which could be regarded as of an average quality. Circulars were issued for the purpose of obtaining the necessary information as to the location of places where ice was harvested, and many samples were collected in the fall of 1888 and the following winter, both of ice of the previous winter's harvest and also of that of 1888–89.

In consideration, however, of the mildness of the season it was thought best to request an extension of the time of making the report, which request was granted. The following winter was also mild, and the ice-crop very light. But the inquiries of the Board were continued, and the result of their investigation was reported to the Legislature as House Document No. 545, and also printed in the present report, (page 145.)

The collection and sale of ice in Massachusetts is one of the well-established industries of the State. The entire ice-

product of the State as stated in the State Census of 1885, was a little less than one million tons, (980,170,) valued at $1,672,932. Since ice is largely employed, not only for the preservation of food, with which it often comes into direct contact, but also for the cooling of water and other beverages, in which it is frequently melted or dissolved, it is a matter of great importance that it should be obtained from sources that are free from pollution.

The lakes, ponds and streams from which ice is cut are in many instances in the immediate neighborhood of populous towns and villages; and while these sources may have been comparatively pure in earlier years, in the beginning of ice collection, the increasing density of population has in many ways contributed to the pollution of such sources in such manner as to greatly imperil them for use as sources of ice supply. The purity of water supplies has for many years been considered an essential condition to the health of communities making use of them, but it has not been until a more recent period that the same condition was also considered as essential to a good ice supply.

It was at one time a popular belief that all impurities were excluded from ice in the process of freezing. Recent observations, however, have proven that while a considerable portion of the impurities of water are excluded or disappear in the process of freezing, it is equally true that some of the more dangerous impurities may survive the ordinary process of freezing and reappear in the melted ice. The harvests of 1888–89 and also of 1889–90 were undoubtedly much less than usual, the deficiency being made up, as it usually is in extremely mild winters, by importation from other states in higher latitudes. At such times Maine and New Hampshire contributed to the supply of Massachusetts. The Kennebec River and its immediate tributaries furnished a crop of new ice amounting to over a half-million tons in the winter of 1888–89, and in other years the yield was much greater. This was chiefly harvested in the towns of Gardiner, Pittston, Richmond and Dresden.

The whole number of companies, firms or individuals reported as supplying ice in the State was 550. From a few cities and large towns no replies were received, and

there are also many small towns in which there are no public ice supplies, individuals obtaining and storing such quantities as are required for family use.

Weekly Mortality Reports.

The mortality of the principal cities and towns of Massachusetts is reported to the State Board of Health weekly by the authorities of these municipalities who are charged with the duty of collecting and registering the statistics relative to the mortality of the population.

These returns are received mainly from the densely settled parts of the State, the cities and large towns. When they were made up and compiled for publication the National Census of 1890 had not been taken and the mortality-rates were made upon an estimate of increase calculated from that of the preceding ten years. This rate of increase having been considerably exceeded in many instances in consequence of an unusual growth, the mortality-rates as stated in the present report are undoubtedly somewhat too high. It was also in consequence of the uncertainty which attends such estimates that no ratios are expressed in the tables of mortality of cities, the actual number of deaths in each week only being given.

The Physique of Women in Massachusetts.

In the eight and tenth reports of the State Board of Health Dr. H. P. Bowditch of Boston contributed two articles upon "the Growth of Children." In the former of these were detailed the results of observation upon about 24,500 children in the schools of Boston, with reference to the differances presented by sex, nationality and grade of schools, and also with reference to the relation of weight to height in growing children. The second paper presented the subject of "the Relative Importance of Mode of Life, and of Race, in determining the size of growing children." The effect of occupations of the parents upon the growth of children was considered and valuable suggestions were presented with reference to the making of anthropometrical measurements.

In the present report, Dr. Bowditch presents a further paper in the same line of inquiry upon "the Physique of Women in Massachusetts," his observations having been made from measurements of young women between the ages of seventeen and twenty-four years, mostly in the higher grades of schools and colleges for women.

Intermittent Fever in Massachusetts.

The appearance of diseases due to malarial infection in Massachusetts in new districts during the past five years, has given rise to an inquiry upon the subject of "Intermittent Fever in Massachusetts," which was entrusted to Dr. C. H. Cook, of Natick.

Dr. O. W. Holmes had carefully collected and compiled the data upon this subject up to the year 1836, which were published in his Boylston Prize Essay of that year.

Dr. J. F. A. Adams, of Pittsfield, in the same line of investigation contributed to the Report of 1880, a report upon the same subject giving the results of inquiries relative to its prevalence in the State up to the date of that publication. It had invaded the valleys of the Connecticut and the Housatonic rivers, and severely affected the population of many cities and towns in Berkshire, Hampden and Hampshire counties.

In 1885 an epidemic of the same character broke out in the town of Framingham, chiefly in that portion of the village of South Framingham lying south of the Boston and Albany Railroad, attacking several hundred of the population and extending in the following year to Natick and other neighboring towns. This epidemic was reviewed and made the subject of a paper in the Report of 1885, by Dr. Z. B. Adams of Framingham.

In order to obtain a complete record of the course of the disease in the State for the decade following the report of Dr. J. F. A. Adams, the subject was submitted to Dr. C. H. Cook, of Natick, who has compiled the results of his inquiries in a paper in the present report.

During the past year, so far as can be learned its prevalence has not been so wide spread nor so decided in an

part of the State as it was in the years immediately preceding.

The Epidemic of Influenza of 1889–90.

Under the provisions of the statutes the State Board of Health is required to investigate "The causes of disease, and especially of epidemics and mortality, and to gather such information in respect to such matters as it may deem proper for diffusion among the people."

In the month of December, the epidemic of influenza visited the whole North American continent, after having first prevailed throughout the whole of Western Europe; and while so far as our present knowledge of this disease extends, it appears beyond the range of possibility to class it among the preventable diseases which are more or less amenable to the action and control of sanitary authorities, — yet in consequence of its widespread character and its serious effect upon the general population, it was decided important to put on record such an account of it as could be gathered from the observation of medical men and others throughout the State.

The report comprises the results of observations by about 400 persons, about one-half of whom were physicians, and the remainder were superintendents of mills, factories, shops, or public institutions, or other persons employing large numbers of people.

At the time of present writing, later in the season, it is plain that the effects of the epidemic were not confined to the limited period of its prevalence in the three winter months. For several months afterward deaths were frequently recorded which must be attributed to illness contracted during the epidemic period.

Among the replies to the circular of the Board which were received in February last, eleven physicians stated that they themselves were sensibly ill from its effects, in some cases to such an extent that they were totally incapacitated for active practice, and of this number three died either at the time of the epidemic or during the ensuing season.

The thanks of the Board are due to all who replied to the

circulars which were issued. The replies were made with unusual promptness, and without them this valuable record could not have been made.

Health of Towns.

A brief digest of the reports of boards of health is presented at the close of this report, made up from such reports as have been received at the office. In addition to these a statement is made as to the causes and conditions which prevailed in the city of Lawrence in connection with an increased death-rate in 1889. The principal cause of the increase appears to have been the unusual prevalence of diphtheria in the latter half of the year. With the aid of Dr. J. C. Bowker of Lawrence, an inquiry was made with reference to the causes and conditions which prevailed in that city during the past year, and the results of the inquiry are presented in this section of the report.

Local Boards of Health.

The urgent need of better local health organizations in the towns has been frequently made the subject of comments in previous reports of the Board, and the necessity of a more definite provision in the statutes becomes apparent every year.

The necessity for improvement is most evident in those towns in which the population is increasing with considerable rapidity and changing gradually from their condition of country villages to that of populous towns. In the cities, boards of health exist by statutory provisions. In most large towns such boards are chosen, for the reason that the necessity of their existence has become apparent to the people of such communities. There is, however, a large number of towns of smaller size, having populations of 1,500 to 6,000 inhabitants, in which the existence of such boards, and their tenure is a matter of much uncertainty. Some such towns have them, others do not; and in some towns they exist for a year or two and then in consequence of some trivial matter their existence ceases, until an urgent demand calls them into exist-

ence again. The statute provides that "if no such board is chosen the selectmen shall be the board of health."

This provision is simply a makeshift, and it should be required that boards of health shall be chosen in all towns, or at least in towns of the larger size. Undoubtedly there are many old towns in the State in which the population is either stationary or diminishing in which the necessity is not so apparent as it is in the larger towns.

Emergencies have arisen, and are constantly occurring every year in which by the neglect or refusal, or incompetency of boards of selectmen to act, epidemics have been suffered to spread, and valuable lives have been lost. The root of this evil (and it is a serious evil), lies in the fact, that for this important duty men are chosen *ex officio*, and not in consequence of expert knowledge or special fitness for the duties involved.

The ordinary duties of selectmen pertain to the management of the economic interests of towns such as the establishment of fire departments, the building of roads, the management and control of public property, for the performance of which duties many men are undoubtedly well qualified; but when to these numerous functions is added that of sanitary administration, too often does it happen that the public wellfare materially suffers. Unfortunately the victims of this statutory deficiency are too often the young and helpless portion of the community, who in the course of mismanaged epidemics are invariably the first to suffer the consequences of neglect on the part of the sanitary authorities. These are not the only instances which illustrate the defects of the present law. A local board of health should be chosen with special reference to its qualification for performing the duties required by law of such a board, and hence the State Board of Health renews its recommendation that a more efficient statute should be enacted than that which now exists.

Manual of Health Laws.

The last edition of the Laws relating to Public Health, which was published by the Board in 1886, having become exhausted, Mr. Lothrop and the secretary were appointed

a committee to prepare a new digest of the laws relating to public health to include all which had been enacted in the years which have elapsed since the publication of the last edition. It was decided to include in the manual in addition to the health laws, the Medical Examiner Act of 1877, with the amendments of later years, and also such portions of the registration laws as pertained to the recording of births, marriages and deaths.

Copies of this manual have been sent to the local boards of health of all the cities and towns in the State.

Circulars upon Infectious Diseases and upon Milk.

The circulars of the Board relating to the principal infectious diseases having become exhausted during the past year, a new and revised edition was prepared by the direction of the board, and copies were sent to each local Board of Health in the State.

The importance of milk as an article of food, is universally recognized, and stringent laws have been enacted to regulate its sale. In recent years, observation has shown that milk is under certain conditions extremely liable to become a vehicle of infection; either on account of the existence of certain diseases in the cows producing such milk, or, in consequence of the introduction of disease germs into the milk from extraneous sources. It was for these reasons that a circular upon milk was prepared and circulated at the direction of the Board.

These circulars are kept on hand by the Board, and are supplied to sanitary authorities, and to all persons who are specially interested in the subjects of which they treat.

The following are copies of the circulars referred to: —

Suggestions for Preventing the Spread of Diphtheria, Revised, December, 1889.

[A Circular from the State Board of Health.]

Diphtheria is a disease of undoubted infectious character. It is communicable either directly by the patient suffering with it, or it may be transmitted through the medium of a third person, or by clothing, or other infected material. The conditions which apparently favor the spread of the disease are, in general terms, infected persons, over-crowding, insufficient ventilation, and possibly polluted water and milk.

Whether or not diphtheria is another form of the disease which is usually called membranous croup, it is certain that the two cannot always be distinguished at the bed side or in the autopsy room, and that what had been supposed to be the milder disease has been the means of communicating the most virulent diphtheria. All cases of diphtheria and croup should therefore be treated by the health officer with similar precautions.

It is thought that closer contact with the air, person, or thing infected is necessary in order to produce the disease than in the case of small-pox, scarlet fever and measles. The discharges and and exhalations from the throat, nose and mouth are particularly dangerous.

The means of transporting the contagium of diphtheria may be furnished by anything that has come in contact with an infected person or object, — air, food, bed and personal clothing, currency, hair, furniture, toys, library-books, wall-paper, curtains, domestic animals, etc. Funerals have occasionally spread the disease, because the exhalations from the dead body are dangerous.

The period of incubation from exposure to the time when the symptoms manifest themselves varies from several hours to two weeks. The average time is variously given from two to five days.

A physicians's certificate of the patient's recovery from diphtheria should always be obtained before attendance at school is resumed by the patient or any member of his household.

It would be well to designate every house where diphtheria exists by some mark sufficient to the give proper information. This plan has been adopted by many local boards with excellent results.

The first principle of treatment is isolation, which can best be fulfilled in a hospital, provided the patient can go there. Otherwise he should be placed in a room as much separated from the rest of the house as possible, and communication with other members of the household should be suspended. If an outward

draught of air from the sick room to the entry exists, a curtain may be formed by a sheet over the door, moistened with a solution of corrosive sublimate.*

The sick room should be well warmed and should be ventilated, — the best method being by an open fireplace with a fire or a lamp in it. The room should be cheerful, open to the sun, free from noise, dust, etc., and not "aired" by cold drafts, which are often more dangerous than a foul atmosphere.

Carpets, upholstered furniture, window hangings, and indeed all unnecessary objects (especially those of woollen), which cannot be readily destroyed or disinfected, should be removed from the room. Bits of carpet may be used as rugs, to be burned after the need for them has passed.

Attendants on the sick should be as few as possible, and should not communicate with other persons any more than necessity requires. They should wear only such clothing as may be readily washed. Clothes used in the sick room should be boiled before being worn elsewhere. Gargling or washing the mouth occasionally with a cleansing fluid is a useful measure for those who must be exposed to contagion.

After recovery, the patient should not mingle with other persons, or use lounges, carriages, public rooms, etc., liable to be used by others, until he has quite recovered and until he has taken warm baths.

After the sick room is no longer needed as such, all the clothing and other matters used in it that can be washed should be disinfected or placed in boiling water at least a half-hour; others should be placed in a hot-air chamber, and kept at a temperature of 240° F. for not less than two hours. Any articles of trifling value should be destroyed by fire. The room should be closed as tightly as possible, and sulphur burned in it in the proportion of 3 pounds to each thousand feet of air space; it should be kept closed twelve hours, and then opened for several days to the air and sunshine. The floor and wood-work should then be thoroughly washed with soap and hot water. Scraping and re-painting would not be considered an excess of caution in time of epidemics; the wall-paper should then be soaked with a five per cent. solution of carbolic acid, removed and burned, and the ceiling should be washed with soap and hot water, or scraped.

Should the patient die, the body ought not to be removed from the sick room until it has been tightly sealed in the coffin, with

* A solution of corrosive sublimate (1 part to 1,000 of water) is recommended by the Committee on Disinfectants of the American Public Health Association for the disinfection of sick rooms, for disinfecting the walls and wood-work.

corrosive sublimate, chloride of lime, or some similar agent. *The funeral should be strictly private*, and not attended by children.

Filth is a predisposing cause of diphtheria, whether in contaminated water supplies or foul air from privies, cesspools, sink-spouts, unventilated soil-pipes, drains or water-closets, etc. Perfect cleanliness should therefore be enjoined. Sewer gas, of course, is a kind of filth which may bring to a person's chamber, if it has access thereto, the contagium brought from another and infected chamber. Overcrowding is one of the most active ways of propagating contagious disease. Finally, *fresh air* and an abundance of soap and water are among the best disinfectants.

The discharges from the throat, nose and mouth of the patient should be put in a vessel containing a strong solution of some disinfectant, and the vessel should be frequently washed with hot water; they should not be received upon anything which is to be kept. Pieces of soft cloth may be used in place of pocket-handkerchiefs, and then at once burned. The breath should be kept as pure as may be by cleansing gargles and washes for the mouth (chlorinated soda, permanganate of potash, etc.). The discharges from the kidneys and bowels should be disinfected with a strong solution of chloride of zinc or a solution of bichloride of mercury, 1 part to 1,000 of water. Carbolic acid may be added as a disinfectant to the slops, and to the water in which the patient has washed or bathed, before throwing it out. The bed clothes, towels, etc., when soiled, should be removed with proper care, placed in a hot disinfecting solution, and be boiled for not less than half an hour. The food left uneaten should never be carried where it may infect other persons.

While the sick room is occupied, it is doubtful whether any disinfectant can be used of sufficient strength to destroy the contagium in the room. Many substances, however, do destroy organic matter by oxidation, and in that way at least contribute to cleanliness if nothing more. For that purpose it is desirable to use corrosive sublimate, chlorinated soda, chloride of zinc, permanganate of potash, etc., because they have no unpleasant smell of themselves.

In our State the law gives to each local board of health full authority to take every step that is needed in the preventive measures to be adopted in case of diphtheria.

Attention is called to the following statutes enacted in 1884, which provide definite and specific requirements in relation to this disease: —

[Chap. 64.]

An Act to prevent the Spread of Contagious Diseases through the Public Schools.

Be it enacted, etc., as follows:

The school committee shall not allow any pupil to attend the public schools while any member of the household to which such pupil belongs is sick of small-pox, diphtheria or scarlet fever, or during a period of two weeks after the death, recovery or removal of such sick person.

[Chap. 98.]

An Act concerning Contagious Diseases.

Be it enacted, etc., as follows:

Section 1. When a householder knows that a person within his family is sick of small-pox, diphtheria, scarlet fever or any other disease dangerous to the public health, he shall immediately give notice thereof to the selectmen or board of health of the town in which he dwells, and upon the death, recovery or removal of such person, the rooms occupied and the articles used by him shall be disinfected by such holder in a manner approved by the board of health. Any person neglecting or refusing to comply with either of the above provisions shall forfeit a sum not exceeding one hundred dollars.

Sect. 2. When a physician knows that a person whom he is called to visit is infected with small-pox, diphtheria, scarlet fever or any other disease dangerous to the public health, he shall immediately give notice thereof to the selectmen or board of health of the town; and if he refuses or neglects to give such notice he shall forfeit for each offence not less than fifty or more than two hundred dollars.

Sect. 3. The boards of health in the several cities and towns shall cause a record to be kept of all reports received in pursuance of the preceding sections and such record shall contain the names of all persons who are sick, the localities in which they live, the diseases with which they are effected, together with the date and names of the persons reporting any such cases. The boards of health shall give the school committee immediate information of all cases of contagious diseases reported them according to the provisions of this act.

Sect. 4. The secretary of the Commonwealth shall furnish the boards of health with blank books for the record of cases of contagious diseases as above provided.

Sect. 5. Sections seventy-eight and seventy-nine of chapter eighty of the Public Statutes are hereby repealed.

The Board of Health of Boston at present requires that cases of small-pox, scarlet fever, diphtheria, typhoid fever and typhus fever shall be reported to it. Sufficient power is given to school committees, as well as to boards of health, to restrict the attendance at school of children from infected houses.

These rules for the prevention of diphtheria should be carried out *under the direction of physicians or boards of health.*

Disinfection.

So far as diphtheria is concerned it is believed that *moisture* renders low organisms and their "germs" or spores more readily destructible by chemical means.

Effective disinfection by burning sulphur requires three pounds to each space of one thousand cubic feet. The sulphur should be broken in small pieces, burned over a vessel of water or sand, so as to avoid danger from fire, and, if the room is large, it should be put in separate vessels in different places. The room should be tightly closed for twelve hours and then aired; it is better that the room should be warm than cold, and the air of the room should be moist when exposed to the fumes of sulphur. Most articles may be disinfected if hung up loosely in a room, although it would be an additional safeguard to expose anything thick, like a bed mattress, to prolonged heat at a temperature of about 240° F.; and, indeed, *heat* and steam must, with our present knowledge, be considered *the best disinfectants.* With this end in view, local boards of health are advised to procure disinfecting apparatus and laundries, as is commonly done in other countries, to be used for the sole purpose of disinfecting articles which have been exposed to the infectious diseases.

Recent observations show that a solution of bichloride of mercury (1 part to 2,000) acts with great efficiency in arresting putrefaction and destroying bacteria which have been placed in it. A solution of chloride of zinc (one part of liquor zinci chloridi, U. S. P., to 200 of water) also serves a similar purpose, but with less efficiency. Caustic lime serves well (1 part to 100), but leaves a sediment not always easy to remove. Carbolic acid is in sufficient strength to be effective in the proportion of 2 parts to 100 of water for the disinfection of clothing, and in the proportion of 5 parts to 100 for the disinfection of excreta. The waste chlorides of commerce may also be used. There can be no better auxiliary to local boards of health than an efficient stationary or portable disinfecting apparatus.*

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* In should be borne in mind that the most efficient disinfectants are also active poisons, and care should be taken in their use.

Suggestions for Preventing the Spread of Scarlet fever, Revised, December, 1889.

[A Circular from the State Board of Health.]

Scarlet fever, scarlatina, scarlet-rash canker-rash and rash-fever are names representing varying degrees of severity of a contagious and infectious disease, and each of these varieties is capable of conveying the most severe type. A person may become ill with fatal scarlet fever from association with another with so mild an attack of the disease as not to keep him in the house, much less in bed.

It is generally agreed that scarlet fever is conveyed from one person to another mainly by particles of the epithelium or thin superficial covering which extends over the whole body, under the name of epidermis cuticle, or scarf-skin, and which also lines the inner passages of the body. The exhalations from the outer and inner surfaces of the various parts of the body, and from the excretions also, are capable of transmitting the disease. Upon whatever the contagious matter depends for its dangerous character, it is capable of retaining its power to carry the disease for a long time — certainly many months, and possibly for a year or more.

The means of transporting the contagium of scarlet fever may be furnished by anything that has come in contact with an infected person or object, — air, food, clothing, sheets, blankets, currency, hair, furniture, toys, library books, wall-paper, curtains, domestic animals, etc. Funerals have occasionally spread the disease, the exhalations from the dead body being dangerous.

The period of incubation from exposure to the time when the symptoms manifest themselves varies from several hours to three, and possibly four, weeks. The average time is variously given from six to eight or ten days.

The time at which one who has been ill with scarlet fever may safely mingle with other people is not always easy to determine; but it is, for convenience, usually placed by sanitarians at three or four weeks from the commencement of the illness, as that covers the majority of cases, and it is best to have some arbitrary rule. Even after this period has elapsed exposure cannot be regarded as safe or allowable unless all roughness of the skin, due to the disease, has disappeared, and unless thorough bathing of the whole body and cleansing of the hair have been performed.

It would be well to designate every house where scarlet fever exists by some mark sufficient to give the proper information.

The first principle of treatment is isolation, which can best be in

a hospital, provided the patient can go there. Otherwise he should be placed in a room as much separated from the rest of the house as possible, and communication with other members of the household should be suspended. If an outward draught of air from the sick room to the entry exists, a curtain may be formed by a sheet which has been soaked in some disinfectant; those disinfectant fluids which do not have a disagreeable odor, and do not stain clothing, being preferred.

The sick room should be well warmed, and should be ventilated by an open fireplace with a fire or a lamp in it. The room should be cheerful, open to the sun, free from noise, dust, etc., and not "aired" by cold draughts, which are often more dangerous than a foul atmosphere. A room having a floor with tight joints is preferable to one that is loosely constructed, since the latter is more liable to retain infectious material.

Carpets, upholstered furniture, window hangings, and indeed all unnecessary objects (especially those of woollen), which cannot be readily destroyed or disinfected, should be removed from the room. A smooth, unpapered wall is preferable to a wall covered with paper-hangings. Bits of carpet may be used as rugs, to be burned after the need for them has passed.

The discharges from the throat, nose and mouth of the patient should be put in a vessel containing a strong solution of some disinfectant; they should not be received upon anything which is to be kept. Pieces of soft cloth may be used in place of pocket-handkerchiefs, and then at once burned. The breath should be kept as pure as may be by cleansing, gargles and washes for the mouth (chlorinated soda, permanganate of potash, etc.) The discharges from the kidneys and bowels should be disinfected with a strong solution of chloride of zinc or a solution of bichloride of mercury, 1 part to 1,000 of water. Carbolic acid may be added as a disinfectant to the slops, and to the water in which the patient has washed or bathed, before throwing it out. If cosmoline, vaseline or sweet oil is used for anointing the skin, the scales of epidermis are thereby prevented to a considerable degree from escaping freely into the air; a warm bath daily is also useful for the same purpose. The bed-clothes, towels, etc., when soiled should be removed with proper care, placed in hot water, and boiled for at least half an hour. The food left uneaten should never be carried where it may infect other persons.

While the sick-room is occupied it is doubtful whether any disinfectant can be used of sufficient strength to destroy the contagium within the room. It is especially true of this disease, that the particles of matter which are capable of communicating infec-

tion, may exist in the dust of an infected apartment. This dust, therefore, should not be swept from the floor with a brush or broom, nor should it be brushed off from shelves, or other places where it is liable to lodge, but should be carefully removed by means of mops or damp cloths, which should be frequently washed in boiling water during the operation.

Attendants on the sick should be as few as possible, and should not communicate with other persons any more than necessity requires. They should wear only such clothing as may be readily washed. Clothes used in the sick room should be boiled before being worn elsewhere. Gargling or washing the mouth occasionally with a cleansing fluid is a useful measure for those who must be exposed to contagion.

A physician's certificate of the patient's recovery should be obtained before the children of the patient's family resume attendance at school.

After the sick room is no longer needed as such, all the clothing and other matters used in it that can be washed should be placed in boiling water and thoroughly boiled for at least half an hour; others should be placed in a hot-air chamber, and kept at a temperature of 240° F. for at least two hours. Any articles of trifling value should be destroyed by fire. The room should be closed as tight as possible, and sulphur burned in it; it should be kept closed twelve hours, and then opened for several days to the air and sunshine. The floor and wood-work should then be thoroughly washed with soap and hot water. Scraping and re-painting would not be considered an excess of caution in time of epidemics; the wall-paper should then be soaked with a five per cent. solution of carbolic acid, removed and burned, and the ceiling should be washed with soap and hot water, or scraped. Solution of chlorinated soda is also an excellent disinfectant for washing floors and walls.

Should the patient die, the body ought not to be removed from the sick room until it has been wrapped in a cloth which has been soaked in a solution of bichloride of mercury, chloride of zinc or chloride of lime, and then tightly sealed in a coffin. *The funeral should be strictly private*, and not attended by children.

Anything which deteriorates health tends to render the system liable to any disease; and in that sense filth may be considered to promote scarlet fever, or to increase its mortality. Perfect cleanliness should therefore be enjoined. Sewer air, of course, is a kind of filth which may bring to a person's chamber, if it has access thereto, the contagium brought from another and infected chamber. Over-crowding is one of the most active ways of prop-

agating contagious disease. Finally, *pure air and an abundance of soap and water* are among the best disinfectants.

In our State the law gives full authority to each local board of health to take every step that is needed in the preventive measures to be adopted in case of scarlet fever.

Attention is called to the following statutes enacted in 1884, which provide definite and specific requirements in relation to this disease: —

[CHAP. 64.]

AN ACT TO PREVENT THE SPREAD OF CONTAGIOUS DISEASES THROUGH THE PUBLIC SCHOOLS.

Be it enacted, etc., as follows:

The school committee shall not allow any pupil to attend the public schools while any member of the household to which such pupil belongs is sick of small-pox, diphtheria or scarlet fever, or during a period of two weeks after the death, recovery or removal of such sick person.

[CHAP. 98]

AN ACT CONCERNING CONTAGIOUS DISEASES.

Be it enacted, etc., as follows:

SECTION 1. When a householder knows that a person within his family is sick of small-pox, diphtheria, scarlet fever or any other disease dangerous to the public health, he shall immediately give notice thereof to the selectmen or board of health of the town in which he dwells, and upon the death, recovery or removal of such person, the rooms occupied and the articles used by him shall be disinfected by such holder in a manner approved by the board of health. Any person neglecting or refusing to comply with either of the above provisions shall forfeit a sum not exceeding one hundred dollars.

SECT. 2. When a physician knows that a person whom he is called to visit is infected with small-pox, diphtheria, scarlet fever or any other disease dangerous to public health, he shall immediately give notice thereof to the selectmen or board of health of the town; and if he refuses or neglects to give such notice he shall forfeit for each offence not less than fifty nor more than two hundred dollars.

SECT. 3. The boards of health in the several cities and towns shall cause a record to be kept of all reports received in pursuance of the preceding sections and such record shall contain the names of all persons who are sick, the localities in which they live, the diseases with which they are affected, together with the date and the names of the persons reporting any such cases. The boards of health shall give the school committee immediate information of all cases of contagious diseases reported to them according to the provisions of this act.

SECT. 4. The secretary of the Commonwealth shall furnish the boards of health with blank books for the record of cases of contagious diseases as above provided.

SECT. 5 Sections seventy-eight and seventy-nine of chapter eighty of the Public Statutes are hereby repealed.

The Board of Health of Boston at present requires that cases of small-pox, scarlet fever, diphtheria, typhoid fever, typhus fever and measles shall be reported to it. Sufficient power is given to school committees, as well as to boards of health, to restrict the attendance at school of children from infected houses.

The rules for the prevention of scarlet fever should be carried out *under the direction of physicians or boards of health.*

Disinfection.

So far at least as scarlet fever is concerned it is thought that actual experiments have proved the efficiency of the method given below. *Moisture* renders low organisms, and their "germs" or spores, more readily destructible by chemical means.

Effective disinfection by burning sulphur requires three pounds to each space of one thousand cubic feet. The sulphur should be broken in small pieces, burned over a vessel of water or sand, so as to avoid danger from fire, and, if the room is large, it should be put in separate vessels in different places. The room should be tightly closed for twelve hours and then aired; it is better that the room should be warm than cold, and that the air should also be moist. Of course during the process of disinfection by sulphur fumes the air of a room is irrespirable. Most articles may be disinfected in a room if hung up loosely and exposed to the fumes of sulphur, although it would be an additional safeguard to expose anything thick, like a bed-mattress, to prolonged heat at a temperature of about 240° F.; and, indeed, *heat* or steam must, with our present knowledge, be considered *the best disinfectant.* With this end in view local boards of health are advised to procure disinfecting apparatus and laundries, as is commonly done in other countries, to be used for the sole purpose of disinfecting articles which have been exposed to the infectious diseases.*

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* Note. — For this purpose a tight apartment of brick or iron is necessary, to the interior of which hot air or steam may be applied. It should be constructed to contain from 200 to 1,000 cubic feet of air space or more, as may be necessary.

Dr. Parsons formulates the following as requisites for a good disinfecting chamber: —

"1. A uniform distribution of heat in all parts of the chamber.

2. The maintenance of the heat with constancy at any required degree.

3. A trustworthy index to the actual temperature of the interior, at the time being.

4. Rapidity of action, both in the first getting up of heat and in effecting disinfection; and

5. Economy of first cost, and of working."

It is necessary that all tightly packed bales or bundles of clothing or other infected material should be opened, and the contents loosely separated, in order to ensure thorough disinfection.

Observations show that a solution of bichloride of mercury (1 part to 2,000) acts with great efficiency in arresting putrefaction and in destroying bacteria which have been placed in it. A solution of chloride of zinc (one part of liquor zinci chloridi, U. S. P., to 200 of water) also serves a similar purpose, but with less efficiency. Caustic lime serves well (1 to 100), but leaves a sediment not always easy to remove. Carbolic acid of sufficient strength to be effective should be in the proportion of 2 parts to 100 of water for the disinfection of clothing, and 5 parts to 100 for the disinfection of excreta. Stronger solutions of all these agents must be used, in proportion to the amount of filth to be disinfected.

Suggestions for the Prevention of Typhoid Fever.

A Circular from the State Board of Health of Massachusetts.

[*Revised*, December, 1889.]

Mode of Propagation.

Typhoid fever is an infectious disease. It is undoubtedly communicable, though not positively contagious in the restricted sense of personal contact. It is conclusively demonstrated that the poison of typhoid fever is conveyed from the sick to the well through the medium of the fecal discharges, and that such is the most common method of its transmission. The usual media of communication are the air and the drinking-water, more commonly the latter. Its introduction by food, especially by milk, has also been demonstrated.

The PURIFICATION AND PROTECTION OF PUBLIC AND PRIVATE WATER SUPPLIES FROM POLLUTION is one of the most important measures for the prevention of this disease. The Caterham epidemic, which occurred in England in 1878, in which 352 cases and 21 deaths followed the pollution of a public water supply by the typhoid excrement of a single person, and more recently the epidemic at Plymouth, Pa., which was still more destructive, and where a similar origin was distinctly traced, are noted examples of the consequences following the pollution of public water supplies.

Single cases and detached groups of cases commonly owe their origin to polluted private wells in close proximity to cesspools, vaults, and other sources of contamination. Hence, isolated

farm-houses and thinly settled districts, as well as small, but compact villages without a public water supply, are more liable to the occurrence of the disease than cities having a public supply.*

Duties of Local Authorities with Reference to Typhoid Fever.

1. To investigate the source or origin of the disease, and to take measures to prevent the pollution of water supplies, if such be shown to be its mode or medium of communication; and if the water supply consists of a private well, to prohibit its use until the source of its infection is removed. In some cases it may be necessary to fill the well, or close it permanently when it is impossible to remedy the pollution of the neighboring soil.

2. Since it is possible that the infection of typhoid fever is occasionally communicated through the medium of the air, it is important that certain precautions should be observed for the prevention of this mode of infection. Efficient ventilation is therefore recommended for all houses occupied by infected persons, and especially of the apartments occupied by the sick. For the prevention of infection in houses not infected, there should be a careful inspection of the plumbing and draining systems, and immediate remedy of all defects in them, in order that no air may find entrance to the house from sewers, cesspools or vaults through leaks in pipes, or through the absence of a sufficient water-seal, or other inefficiency of traps.

3. Isolation of the sick. While the separation of the sick from the well should be required, it is not essential that the same restriction as to intercourse should be required as is necessary in the case of small-pox or scarlet fever, since there is no evidence that this disease is conveyed from the sick to the well through the medium of a third person.

4. Disinfection of the intestinal discharges of persons sick with the disease should be required; also the disinfection of soiled bedding, clothing, utensils, and apartments used by them.

5. Notice of each case should be required from the attending physician in compliance with the provisions of the Public Statutes. Such notice should contain the name, age and residence of the patient, the date of the first visit, and the name of the reporting physician. Postal cards or blank forms may conveniently be used for this purpose.

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* An account of a recent epidemic of this character may be found in the 20th Report of the State Board of Health, 1888, page xl.

The amendment to the Public Statutes, enacted by the Legislature of 1884, relative to diseases dangerous to public health, is as follows: —

[Chapter 98, Acts of 1884.]

Section 1. When a householder knows that a person within his family is sick of small-pox, diphtheria, scarlet-fever or *any other disease dangerous to the public health*, he shall immediately give notice thereof to the selectmen or board of health of the town in which he dwells, and upon the death, recovery or removal of such person, the rooms occupied and the articles used by him shall be disinfected by such householder in a manner approved by the board of health. Any person neglecting or refusing to comply with either of the above provisions shall forfeit a sum not exceeding one hundred dollars.

Sect. 2. When a physician knows that a person whom he is called to visit is infected with small-pox, diphtheria, scarlet-fever or *any other disease dangerous to the public health*, he shall immediately give notice thereof to the selectmen or board of health of the town; and if he refuses or neglects to give such notice, he shall forfeit for each offence not less than fifty nor more than two hundred dollars.

Sect 3. The boards of health in the several cities and towns shall cause a record to be kept of all reports received in pursuance of the preceding sections, and such record shall contain the names of all the persons who are sick, the localities in which they live, the diseases with which they are affected, together with the date and the names of the persons reporting any such cases. The boards of health shall give the school committee immediate information of all cases of contagious diseases reported to them according to the provisions of this act.

Sect. 4. The secretary of the Commonwealth shall furnish the boards of health with blank books for the record of cases of contagious diseases as above provided.

Sect. 5. Sections seventy-eight and seventy-nine of chapter eighty of the Public Statutes are hereby repealed.

The Board of Health of Boston at present requires that cases of small-pox, scarlet-fever, diphtheria, typhoid fever and typhus fever shall be reported to it.

These directions for the prevention of typhoid fever should be carried out *under the direction of boards of health or physicians*.

It is desirable to include the following particulars in such a notice as is required in the Act quoted above: —

Notice of Infectious Disease.

Name of Patient, ______________________

Age of Patient, ______________________

Disease, ______________________

Residence, ______________________

______________________ M.D.

Date,

Disinfection.

The following are recommended as the most efficient disinfectants for use in connection with this disease: —

For the disinfection of excreta. — A solution of chloride of lime in the proportion of 4 parts of the chloride to 100 of water.

For the disinfection and deodorization of the surfaces of masses of organic material in privy-vaults, etc. — Chloride of lime in powder.*

For clothing, bedding, linen, etc. — Burning, if the articles are of little value; boiling, for at least half an hour; immersion in a solution of bichloride of mercury, of a strength of at least 1 part to 2000 of water, for at least four hours; immersion in a 2 per cent. solution of carbolic acid for four hours.

For outer woollen garments which might be injured by the foregoing methods. — Exposure to dry heat at a temperature of 230° F. (110° C.) for two hours; fumigation with sulphurous acid gas in a closed apartment, in moist air, where the sulphur employed is in the proportion of 3 pounds to each 1000 cubic feet of air space.

For the person. Hands, or other portion of the body liable to be soiled. — Solution of chlorinated soda, 1 part to 10 of water; solution of carbolic acid, 2 parts to 100 of water.

For the bodies of the dead. — Wrap in a sheet saturated with a solution of chloride of lime, 4 parts to 100 of water, or of bichloride of mercury, 1 part to 500 of water, or of carbolic acid, 5 parts to 100 of water.

For the sick room, after the death or recovery of the patient. — Fumigation with sulphur for twelve hours, at least 3 pounds being used for each 1,000 cubic feet of air space, to be followed by the washing of surfaces with a solution of bichloride of mercury, 1 part to 1,000, or of carbolic acid, 2 parts to 100 of water. For the fumigation the sulphur may be broken in pieces, and put into an iron dish or other vessel, and set in a basin of sand, or floated in a tin pail partially filled with water. It may be set on fire by sprinkling it with some alcohol and applying a lighted match. The air of the apartment requiring disinfection should be moist at the time of disinfection. The apartment cannot be occupied during such fumigation, but should be tightly closed for at least twelve hours, and should be well aired after the disinfection is accomplished.

As it has been conclusively demonstrated that the fecal discharges of the sick are the chief vehicle of communication in this

* The chloride of lime for this purpose may be dilluted with nine parts of plaster of Paris, or the same proportion of clean dry sand.

disease, their disinfection should be carefully and thoroughly performed, and especially should care be taken as to their disposal, so that no portion of them can gain access either directly or indirectly, by surface drainage, percolation, filtration, or otherwise, to any water supply. It is also important that such discharges should not be deposited in vaults, drains, cesspools or sewers, without previous thorough disinfection.

Circular of the State Board of Health relative to Milk; its Production, Preservation, Care, Transmission and Sale.

Office of the State Board of Health,
13 Beacon Street, Boston.

The reasons for the almost universal use of milk at all periods of life are undoubtedly to be found in its harmonious combination of all the food elements which serve for the nutrition of the body, in a form well suited for digestion, especially for the young. Of its solid constituents, about one-third consists of albuminous compounds, a little more than one-third of hydro-carbons, a little less than a third of fat in its most digestible form, and a small fraction of mineral salts, such as are needed to supply the salts of the body. The proper combination of all these ingredients undoubtedly makes milk the most important of all foods. But its complex composition in a liquid form subjects it to rapid deterioration on exposure to the air, and also renders it more liable to adulteration by several different methods than any other article of food. The greatest care is therefore necessary to insure its freedom, on the one hand from the danger of communicating those serious ills whose existence and development are promoted by the presence of filth, and on the other hand from those evils which are due to fraudulent practices too often conducted before milk reaches the house of the consumer. Unfortunately the latter evil not unfrequently conveys a liability to the existence of the former.

Transmission of Disease Germs by Milk.

Those animals only should be selected for milk production which are known to be absolutely free from disease.

Distinction should be made between those diseases which are liable to transmission directly from the cow through the medium

of milk, of which at present the number recognized is small, and those which may be transmitted through the medium of the milk independently of the cow. Of the former class of diseases scarlet fever, or at least a disease of short duration very closely resembling it, has been shown to exist occasionally in milch cows and also to have been transmitted by them through the medium of milk to mankind. Of far greater importance, however, is the disease known as tuberculosis, or consumption, which is of quite common occurrence among cows. The existence of infection in the milk of tuberculosis cows appears to have been proven by Koch, and in this country Dr. Ernst has also shown that such milk may be infectious even though the udder of the cow is not involved in the disease. As a result of his recent inquiries Dr. Ernst states: —

1. That the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease.
2. That the virus is present whether there is disease of the udder or not.
3. That there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis.
4. That, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis but with no discoverable lesion of the udder.

Dr. Heim, in a report to the Royal Board of Health of Germany, states that the bacilli of tuberculosis remain capable of development for ten days in fresh milk, and in milk gradually undergoing decomposition they lost their vitality in a period varying from ten days to four weeks.

In view of these facts, therefore, it is quite plain that the greatest care should be manifested in the selection of milch cows, and that all animals affected with tuberculosis, sometimes known as "pearl disease" (*perlsucht*) should be rejected from the list of food-producing animals.

That typhoid fever may be transmitted through the medium of milk does not admit of doubt, such cases having come to the knowledge of the Board not unfrequently within the past three years. There is no evidence that the cow herself is in any way concerned in such transmission, the evidence presented having usually pointed to the water supply as the medium from which the infection was received into the milk either by means of water intentionally introduced for fraudulent purposes, or by means of the water used in washing the cans or other vessels employed in milking the cows or transporting the milk to market.

With reference to the transmission of the germs of typhoid fever through the medium of milk, Dr. Heim says, as the result of his observations, that they remained alive and capable of development in milk at the end of thirty-five days, but not after forty-five days. Cholera germs were still visible after remaining six days in milk which had undergone no antiseptic treatment; in milk of the same kind which had been kept in a refrigerator no living bacteria were found at the end of three days.

All of these germs of dangerous infectious diseases may remain active in fresh milk for a considerably longer period than it is customary to keep it for use.

Food of milch cows. — As it is beyond the province of this Board to usurp the functions of the agriculturist, general principles only, relative to feeding, will be stated. The food of the milch cow should be nutritious, and of sufficient quantity to keep the animal in good condition during the milk-producing period. The feeding of fermented or of partially fermented food to milch cows, especially of decomposed garbage and offal of towns, cannot be to strongly condemned.

With reference to the use of exhausted foods, or those from which the essential nutritious ingredients have been largely removed, Prof. Charles Girard, Director of the Paris Municipal Laboratory, says, "They should be condemned by all milk producers who desire to furnish healthful and nutritious milk. . . . The forcing plan, whereby the animal is tied up throughout the year and compelled to eat food which she invariably loathes at first, makes of her a mere milk-machine, and the production of a healthful flow of milk becomes an impossibility."

(For further suggestions on this subject, see Health Supplement No. 5, 1883, pp. 102-107.)

Water Supply. — It is essential that the water supply used by the animals concerned in the production of milk, and also for all other dairy purposes, should be absolutely free from the possibility of contamination. Too often does it happen that the cows are compelled to drink the water either of a polluted stream or of a well dug or driven * either in the barn-yard, the barn cellar or in the neighborhood of some cesspool, vault or manure heap, and the same water is also used for other dairy purposes. The water used in washing cans and milk-pails should not be merely warm, but in all cases should be scalding hot.

Care. — The stables used for housing milk-producing animals should be of ample size, well lighted and ventilated, warm and dry.

* Driven wells are subject to the same influences as other wells.

Special care should be taken to keep those parts of the stable in which the cows are secured as clean as possible. Each animal should have at least 1,000 cubic feet of air space (Ballard). Overcrowding is one of the essential conditions favorable to the production of tuberculosis. The litter, or other material used for bedding, should be clean, dry and frequently renewed.

The milking pails, coolers, cans and all vessels used in connection with the collection, storage and distribution of the milk, should be perfectly clean and should be rinsed with scalding water or exposed to steam after their use.

Since milk rapidly absorbs foul odors which impart an offensive taste and smell to it, it is essential that the milk should not be exposed in open vessels in stables where such odors are liable to exist, and especially in those where the manure of cows, hogs or horses is stored in the cellar below the stable.

The milk should be cooled soon after it is drawn from the cow by setting the cans containing it into a vat, tank, reservoir or trough filled with cold water and kept at a temperature as low as 50° F. It is also desirable that it be delivered to the consumer at a low temperature.

It is absolutely essential that all persons engaged in the care and milking of cows should be of scrupulously clean habits, and if, as not unfrequently happens, any infectious disease makes its appearance in the family of a farmer or dairy-man producing milk for public use, or of a milk dealer selling either at wholesale or at retail, the person or persons so affected should be isolated and not allowed either to milk cows, or to handle any of the vessels used for receiving or containing milk, or in any way to assist or take part in conducting the business of milk production, storage, transportation or distribution to the consumer until the complete recovery and disinfection of the apartments occupied by the sick.

It is needless to add that kind and gentle treatment of milk-producing animals exerts an important influence in securing milk of good quality and an abundant flow.

The foregoing portion of this circular relates mainly to those conditions affecting the quality of milk which exert their action through the animal anterior to the time of its production. There are also other conditions of an entirely different character which affect its quality after its production, which may be grouped in two classes, those which are *natural* and those which are *artificial* conditions.

The principal *natural* conditions are *Temperature* and *Exposure to Germs*. The composition of milk renders it peculiarly fit soil or culture ground for the propagation of micro-organisms of various

kinds, not only for those of putrefaction and of disease but also for many others. A moderate temperature is essential to the development of putrefactive germs and the consequent rapid deterioration of the milk; hence it is evident that a low temperature must necessarily prevent or retard such processes.

Since exposure to germs is an essential condition to such development of decomposition, it is plain that milk may be preserved for a long period after it has once been sterilized by excluding the germs from it.

Since it has been determined that the sterilization of milk is an important matter as a preventive of some of the digestive disturbances of young infants and possibly of older persons, a brief explanation of the process is offered.

Sterilization of milk consists in destroying the putrefactive or other germs in it. The simplest and best form of sterilization consists in boiling the milk and preventing the access of germs. Other methods involving the addition of foreign substances intended to act as antiseptics are open to decided objections.

Milk may be sterilized in the following mode: —

One or more glass bottles must be provided having perforated rubber stoppers, each stopper being fitted with a smaller glass stopper for the opening. These flasks may be sterilized by heating them in an oven at a mild baking heat for a half hour. The milk, either diluted or undiluted, and sweetened if necessary, is put into the flasks, the rubber stoppers are inserted, the perforated openings being left unclosed. These flasks or bottles should be put into a tray or rack made to fit them, and lowered into a vessel of water which is brought to the boiling point and the boiling continued for fifteen minutes. The glass stoppers are inserted immediately on taking out the flasks. Cotton-wool pledgets may be used instead of glass stoppers, and the bottles may be steamed instead of boiled, being kept a short distance above the boiling water. They may be then taken out and cooled. Each bottle may be warmed when needed for use, and, if for an infant, a stout rubber nipple attached to the mouth. It is needless to add that these nipples should be scrupulously clean.

The *artificial* conditions which affect the quality of milk favorably after its production may be enumerated as follows: —

1. Length of time which elapses between production and consumption. Rapidity of transmission and sale is desirable. The perishable character of the milk renders this condition imperative. The use of preservatives in general should not be sanctioned. These means, together with the use of coloring

matter, are much more likely to be resorted to in cases where milk is not delivered within twenty-four hours after its production, and are too often a cloak for fraudulent practices.

2. The small ratio of milk-producing animals to the population (beyond a certain limit) influences the quality of milk.

3. Density of population. The milk of the densely settled territory near the larger cities is generally of poorer quality than that of the western counties of the State.

4. Distance of the producer from the consumer. In general terms, the nearer the producer to the market the better the quality of the milk.

5. Increase in the number of middle-men.

If the milk is to be transported to a considerable distance, a sterilized cork may be inserted upon the cotton pledget, and in either case the bottle should be baked before use, and the steaming kept up for a long time, or repeated if permanent results are desired. It is also important that the milk to be sterilized should be as fresh as possible.

Routine Work of the Board.

During the year ending Sept. 30, 1889, the Board held fourteen meetings, and seventeen meetings of standing committees of the Board were held during the same period.

Four public hearings were also held relating to questions arising under the provisions of chapter 375 of the Acts of 1888.

Forty-two applications were received for the advice of the Board during the year from the authorities of cities and towns, and from corporations, individuals and the trustees of public institutions, relative to the sources of water supply and the sewerage and sewage disposal. Official replies were sent to each of these parties, the substance of which was published and transmitted to the Legislature as Senate Document 4, 1890.

During the year 5,454 samples of food and drugs were examined by the chemists of the Board. About 150 cities and large towns were visited by the inspectors for the purpose of collecting samples of food and drugs. One hundred and forty complaints were entered in the courts for violation of the Food and Drug acts, and the monthly

summary of the work done has been published and sent to the local boards of health throughout the State. The details of this department of work will be found in that part of the report relating to Food and Drug Inspection.

The mortality statistics of such cities and towns as have furnished them to the Board have also been compiled each week at the office of the Board and published for the information of local boards of health and for the people of the State.

Under the provisions of chapter 375 of the Acts of 1888, more than 2,000 samples of water have been examined both chemically and biologically by the experts of the Board, together with a large number of samples of sewage. The results of this work, and the details of the important observations made at the Experiment Station of the Board at Lawrence, will be found in the two volumes upon Water Supply and Sewerage now being printed.

Many visits have been made by the secretary and engineers during the year for the purpose of inspection with reference to such matters as have been referred to them for investigation.

Recommendations.

For the more efficient execution of the laws relating to food and drug inspection, the Board recommends the appropriation of the sum of $1,500 in addition to the amount appropriated in 1889.

The repeal of sections 103, 104 and 105 of chapter 80, relating to water supply, is recommended for the reasons already stated in previous reports.

The Board renews its recommendation that a more efficient statute relating to the appointment of local boards of health in towns should be enacted in place of the existing law.

Expenses of the Board.

The following is a statement of the expenditures of the Board for the year ending Sept. 30, 1889, under the provisions of the three different acts by which it is authorized to make such expenditures: —

General Expenses of Board.

Salaries,	$4,706 00
Stationery,	253 24
Telephone,	122 65
Printing,	1,277 62
Apparatus,	64 85
Express,	23 80
Postage,	21 50
Advertising,	21 45
Special investigations,	659 80
Travelling,	761 24
Office incidentals,	36 80
Telegrams,	2 25
Bookbinding,	46 65
Books,	166 86
Total,	$8,164 71

Expenses of Food and Drug Inspection from Oct. 1, 1888, to Sept. 30, 1889.

[Chap. 289, Acts of 1884.]

Dr. E. S. Wood,	$1,125 00
Dr. B. F. Davenport,	1,500 00
Dr. Charles Harrington,	975 03
Prof. C. A. Goessmann,	500 00
Dr. C. P. Worcester,	566 66
John H. Terry,	1,200 00
Horace F. Davis,	1,000 00
John F. McCaffrey,	796 67
Travelling expenses and purchase of samples,	2,197 19
Legal services,	393 60
S. P. Sharples,	33 00
Bottles, corks and other incidentals,	69 12
Total,	$10,156 27

Water Supply and Sewerage.

[Acts of 1888, Chap. 375.]

Salaries,	$17,326 75
Travelling expenses,	670 89
Rent of Massachusetts Institute of Technology,	1,950 00
Experiment Station at Lawrence (labor, rent and materials),	5,380 67
Rent of 161 Tremont Street,	35 42
Stationery and printing,	153 30
Apparatus,	276 46
Maps, plans and books,	209 15
Postage, express and telegrams,	526 33
Advertising hearings,	5 00
Total,	$26,533 97

HENRY P. WALCOTT,
JULIUS H. APPLETON,
ELIJAH U. JONES,
JOSEPH W. HASTINGS,
HIRAM F. MILLS,
FRANK W. DRAPER,
JOHN M. RAYMOND,

State Board of Health.

WATER SUPPLY AND SEWERAGE.

WATER SUPPLY AND SEWERAGE.

Under the provisions of chapter 375 of the Acts of 1888, the State Board of Health is required "to consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having, or intending to introduce, systems of water supply, drainage or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their drainage or sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. It shall also from time to time consult with and advise persons or corporations engaged, or intending to engage, in any manufacturing or other business, drainage or sewage from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal or purification of such drainage or sewage: *provided*, that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. All such authorities, corporations, firms and individuals are hereby required to give notice to said Board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and sewage; and all petitions to the Legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said Board thereon."

Since the date of the last report (Senate Document 4, 1889), and up to that of the present report (Senate Document 4, 1890), applications for the advice of the Board under the terms of this act have been received from the following

cities, towns, corporations and individuals. In several instances more than one application was received from the same source, in consequence of advice given in regard to the first proposed plan, or for other reasons.

Applications were received relative to water supply from Malden, Leicester, Canton, Revere (three applications), North Adams, Pittsfield, Marblehead, Avon (two applications), Fairhaven, Reading, Hinsdale, Stockbridge (two applications), the Ludlow Manufacturing Company, North Easton, from the Adjutant-General (relative to a water supply for the State camp ground at Framingham), Medford, the Riverside Water Company (in Gill), Provincetown, Ipswich (two applications), Newton, Dracut, North Brookfield, Attleborough Fire District, Bradford, Andover, Lenox, Quincy, Springfield (two applications), Brant Rock (in Marshfield), Foxborough, Southborough and Stockbridge.

Those which related to sewerage and sewage disposal were from Gloucester, Northampton, Westfield, Revere, Winthrop, Pittsfield, the trustees of the State Normal School at Framingham, Everett, the trustees of the Massachusetts School for the Feeble-minded in Waltham (two applications), Franklin, Medway, Marlborough and Gardner.

Water Supply.

Malden. The city of Malden has been supplied for several years with water from Spot Pond, a sheet of water lying in the town of Stoneham, which also supplies the towns of Melrose and Medford. As it appeared probable that this source of supply would soon prove inadequate for the rapidly growing population of these municipalities, the city of Malden, the most populous of the three places, obtained a tract of land in the easterly part of the city, and, having constructed some test-wells in this tract, applied to the Board (Aug. 9, 1888) for advice relative to these wells as a source of public water supply. The Board replied as follows: —

Boston, July 3, 1889.

Application was received dated Aug. 9, 1888, for advice in regard to a further supply of water for Malden, accompanied with

the notice from the city council that it was the intention of the city to obtain such supply from land bought of James T. Eaton. A month later, at the request of the Board, the mayor furnished to the Board data collected by the city in regard to this source of supply.

At this time the city had taken final action and begun to construct the works, hence the question remaining open for advice was then limited to the best practicable method of securing the purity of this source; and, being pressed by requests for advice from other cities and towns requiring immediate action, the consideration of this question has been deferred.

From information obtained from the city and from examinations by the Board, the direct drainage area from which most of the water of this source must be derived is a little less than a square mile, and the daily average quantity of water which can be obtained is estimated to be from 575,000 to 750,000 gallons. This area contains a part of a cemetery, and about 400 houses having an estimated population of 2,400. As there is no sewerage system, the liquid sewage from this population must get into the ground. The houses are nearly all more than a quarter of a mile from the wells.

The chemical analyses of water from the wells, which were made every week during the three months of the test pumping, show a remarkably perfect filtration of the water at that time, rendering it nearly free from organic impurities. This condition of freedom from organic impurity cannot be expected to continue through very dry seasons, when water will be drawn to the wells from more remote and more polluted parts of the drainage area. Still, the water may be continued of good quality for a number of years by the introduction of a complete system of sewerage, and the connection with it of all buildings upon the drainage area contributing to the wells. It will be advisable for the city to control the land around the wells at as great a distance as practicable, to prevent buildings being constructed that would increase pollution in the vicinity.

From an investigation of the resources of Spot Pond and the new wells, it is probable that, with the rapid growth of the city, these two sources will be inadequate to supply all that the city will require in dry seasons, after five years.

LEICESTER. The Leicester Water Supply District having applied to the Board (June 4, 1888) for its advice relative to the region lying in the valley of Kettle Brook in the

northerly part of the town of Leicester as a source of water supply, the Board made the following reply : —

BOSTON, Jan. 28, 1889.

A supply of water by gravity appears to be the best adapted to the wants of the Leicester Water Supply District, and such portions of the town outside of the district as should be considered therewith. A supply of this kind cannot be obtained from any place except the valley of Kettle Brook, above the road leading from Worcester to Paxton. To obtain water of satisfactory quality from the valley, it should be taken from springs, wells or other ground water sources. Whether a sufficient supply of this kind of water can be obtained from such sources, is at present uncertain. The size of the valley, its shape, and other surface features, indicate that a sufficient supply may be obtained ; while, on the other hand, some excavations made by the town point to unfavorable results. A sufficient supply cannot be obtained from the small territory at the head of the valley from which the Leicester Water Supply District is now authorized by the Legislature to take water.

While uncertainty as to the sufficiency of a supply from the valley above the Worcester and Paxton road exists, it is inadvisable to begin the construction of works ; but, as this is the only available source for a gravity supply, further examinations are recommended, to see if this uncertainty cannot be removed. If it should be found that a sufficient quantity of water can be obtained from this source, the Board is of the opinion that it would be the most appropriate source of supply for Leicester.

CANTON. The water commissioners of Canton having applied (Sept. 21, 1888) for the advice of the Board, relative to the propriety of using a well in the course of construction within the limits of Canton as a source of public water supply, the Board replied as follows : —

BOSTON, Jan. 9, 1889.

The water taken from driven wells at the site of the large well now being constructed is of excellent quality. To maintain its purity, sewage from houses in the valley above the well should be conveyed to a point below it, and light should be excluded from the well and standpipe. The works appear to be favorably situated for obtaining a supplementary supply, if the well now being excavated does not furnish all the water required.

REVERE. The Revere Water Company applied to the Board in 1888 for its advice, relative to the use of the water of Pilling's Pond in the town of Lynnfield to supplement their present supply. This source did not meet the approval of the Board (see twentieth report, 1888, page 5); and another application was made by the company (Nov. 14, 1888), relative to the taking of water at a point lower down in the Saugus River valley, to which the Board made the following reply: —

BOSTON, Jan. 9, 1889.

The State Board of Health has carefully considered the application of the Revere Water Company, with reference to obtaining an additional supply of water from some point in the Saugus River valley above the highway running from North Saugus to Wakefield; and is of the opinion that a surface water supply from the Saugus River below Quannapowitt Lake in Wakefield would not be of satisfactory quality. Test pipes driven by the Revere Water Company in the valley between the highway above mentioned and the South Reading branch of the Boston & Maine Railroad, and an examination of the surface of this territory, indicate it to be an unfavorable one for obtaining a ground water supply. The Board thinks it probable that examinations for a ground water supply further up the valley might yield more satisfactory results.

The company then made application (Jan. 7 and Feb. 1, 1889) for advice as to certain sources in the town of Saugus, to which the Board replied as follows: —

BOSTON, Feb. 28, 1889.

The State Board of Health has considered the application of the Revere Water Company for advice in regard to two additional sources of water supply in the town of Saugus, to be used in the towns of Revere and Winthrop.

First. A ground water source located near some wells now flowing a short distance below the junction of two brooks, east of the Newburyport turnpike and about one-third of a mile northwest of the Pleasant Hill station of the Saugus Railroad.

Second. A surface water supply, to supplement the former, from Central Brook, near the border of Saugus and Melrose.

The first of these sources would furnish at present a water of good quality, but the data yet received leaves the quantity uncertain. Taking water from this source must be subject to whatever rights remain to the Saugus Water Company, incorporated by

chapter 235 of the Acts of 1886; and, situated as it is within the town of Saugus, it can but be regarded as a more appropriate source of supply to the town of Saugus than for any other town, if the town of Saugus desires to be so supplied. At present the town of Saugus is supplied with water by Lynn, under the authority of chapter 256 of the Acts of 1883.

The second of the proposed sources, Central Brook, on account of the population on the watershed and the character of the valley immediately adjoining the brook, will furnish a water of somewhat inferior quality, which will become worse with growth of population, until before many years it will be unfit for water supply purposes. From the beginning much care would have to be exercised to prevent pollution from entering the stream, especially from the village of Greenwood in Wakefield, and the outskirts of the village of Melrose Highlands, which are in the upper part of the watershed. If water is taken from this source, a suitably constructed reservoir, as large as that indicated by the plan submitted, should be provided. In taking the water from Central Brook, provision should be made for the rights already granted to the city of Lynn to take water from Saugus River.

These two sources, taken together, would furnish all of the water needed by Revere and Winthrop for the next fifteen years or more; and they have the advantages of nearness to the present works of the Revere Water Company, and of economy of operating, over any other sources.

If the immediate desires of the town of Saugus and the existing rights of the city of Lynn do not preclude the taking of these waters for the use of the towns of Revere and Winthrop, the State Board of Health regards them as appropriate sources of a temporary supply for Revere and Winthrop.

The Board deems it necessary to qualify its conclusions; for it must be evident, that, situated as these drainage areas are within eight miles of the State House, they are likely before many years to contain so large a population that it will be impracticable to prevent these waters from becoming unfit for domestic purposes; and in the opinion of the Board, if rights are granted to the Revere Water Company for taking water from these sources, they should be so limited that they should cease rather than that unusual burdens should be imposed upon the inhabitants of these drainage areas to keep the waters from becoming polluted.

North Adams Fire District. The prudential committee of the North Adams Fire District having applied to the

Board (Nov. 28, 1888) for its advice relative to the taking of Broad Brook in Pownal in the State of Vermont as a source of water supply, the Board replied as follows: —

BOSTON, Feb. 6, 1889.

The water supply of the district is at present obtained chiefly from Notch Brook, but as this source does not furnish a sufficient quantity of water during dry seasons, a supplementary supply is then obtained from wells. The wells are liable to be polluted by the large population in the territory draining towards them, and the water from them is so hard that its use is objected to by the water takers. An additional source of supply should, therefore, be sufficient to provide for many years all water that will be needed, in addition to that obtained from Notch Brook in the dryest season, for the population of the fire district, with its increase by natural growth and by extension of its limits.

From the information furnished by the authorities and the investigations made by the chief engineer, the Board is of opinion that the natural flow of Broad Brook will be insufficient to supply the needed quantity, and there is at present not enough evidence to show that storage reservoirs can be constructed to increase the flow to the required amount during dry seasons. The situation of the proposed source beyond the limits of Massachusetts is regarded as a serious disadvantage.

The Board advises the North Adams Fire District not to accept Broad Brook as its source of additional supply, until it has determined, by careful examinations and surveys made by a competent engineer, the probable flow of Broad Brook in dry weather and the amount this flow can be increased by the construction of suitable storage reservoirs, together with the entire cost of bringing water from this source to North Adams. The Board further advises that a sufficient examination be made of other sources of supply in the southerly portion of Williamstown, to enable comparisons to be made between them and the proposed source.

The construction of new works will involve the expenditure of a large sum of money; and no source should be decided upon for a town growing so rapidly, until definite information is obtained as to the best source for furnishing an ample supply of water of good quality.

PITTSFIELD FIRE DISTRICT. The water commissioners of the Pittsfield Fire District having requested the advice of the Board (Jan. 19, 1889) relative to the propriety of taking

the water of Sackett Brook in the limits of the town of Pittsfield, the Board replied as follows: —

BOSTON, Feb. 18, 1889.

The Board has had data collected and the ground examined by its chief engineer, as far as this could well be done in winter, without sinking wells, and has reached the conclusion that a valuable addition to the present water supply can probably be obtained near the junction of Ashley and Sackett brooks, and regarding all of the conditions considers this an appropriate source of additional water supply for Pittsfield.

MARBLEHEAD. The water commissioners of the town of Marblehead having applied (Nov. 14, 1888) to the Board for its advice relative to taking water from a ground supply in Salem, near the Marblehead line, the Board replied as follows: —

BOSTON, Jan. 28, 1889.

The State Board of Health has carefully considered the application of the boards of selectmen and water commissioners of the town of Marblehead, with reference to a proposed water supply for the town from the ground in Salem near the Marblehead line and near Loring Avenue. The quality of the water flowing from test wells at this place is excellent, except that it is somewhat harder than is desirable. The Board is of opinion, however, that the quantity of water which can be obtained from this source will not be sufficient for supplying the town.

The Board recommends the town to make further investigations, with the aid of a competent engineer, of sources which may be available for a water supply; and suggests the drainage area of Forest River in the southerly part of Salem, above the reach of the tide, as worthy of special examination with reference to obtaining from it an independent ground water supply, or one to be used in connection with a supply from the source which the town submitted for the advice of the Board. Such information as the chief engineer of the Board may have acquired will be at the service of the town in making its investigations.

AVON. The water supply committee of the town of Avon having applied to the Board (Dec. 26, 1888) for its advice relative to obtaining a water supply from the water works of the towns of Randolph and Holbrook, the Board replied as follows: —

BOSTON, Jan. 1, 1889.

This source appears to the Board an economical and for the

present a reasonable source of supply for the town of Avon. The Board would, however, call attention to the conditions and recommendations already made in the following terms to the towns of Randolph and Holbrook, which will be rendered still more prominent by the future growth of Randolph: —

"Great Pond has, however, unfavorable characteristics, which demand attention. Upon its watershed live about one-quarter of the inhabitants of Randolph, nearly 1,000 people, whose sewage should be kept out of the pond. From about one-half of these houses the sewage can at reasonable expense be turned into the watershed in the south-easterly part of the town, and be disposed of with the sewage from that quarter. The remaining sewage in the drainage area of the pond should be effectually filtered, or otherwise purified so that it will not be detrimental to health, before being turned into the pond or into any of its tributaries."

The town, being unable to obtain a supply from the source named above, then made a new application (Feb. 18, 1889), in which Porter's Brook or Spring was specified as a source of water supply; and the advice of the Board was requested relative to this source. The following reply was made to this application: —

BOSTON, March 23, 1889.

The water from Porter's Spring is of excellent quality, is not likely to become polluted by sewage, and has the advantage of nearness to the village. It is, however, not probable that the spring or any well sunk in its immediate vicinity will furnish a sufficient quantity of water.

It is possible that a supply for the town may be obtained by a system of works which, in addition to water from Porter's Spring, would take water from the ground in the valley of the brook which flows across West Main Street north of Porter's house, and from the valley south of Porter's Spring, from which a brook flows southerly across South Street. To determine whether sufficient water can be obtained from this area, and whether there may be a better source in or near the town, the Board would advise the town to have further examinations made.

FAIRHAVEN WATER COMPANY. The proposed source of supply named in the application of this company (mentioned in the report of 1888) having been considered by the Board as inadequate, a new application was submitted (Dec. 19, 1888), relative to the use of water from wells in the lower

part of the valley of the Mattapoisett River. To this application the Board replied as follows: —

BOSTON, March 11, 1889.

The Board thinks it is not advisable to take water directly from Mattapoisett River, and it has not received from the water company the results of any examinations of the ground which indicate the quality or quantity of water that may be obtained from wells; but, from its own examinations, made in winter, of the topography of the surrounding country and the surface in the neighborhood of the proposed source, the Board is of opinion that the locality is worthy of careful examination, and advises the water company to have such examinations made, under the direction of an engineer skilled in this kind of work, as will determine the quality and quantity of water that may be obtained from the ground, and, if these results are favorable, the best location for permanent works.

READING. The town of Reading having applied for the advice of the Board (Jan. 26, 1889) relative to certain proposed means of water supply (from driven wells in the town of Reading, and from the Wakefield Water Company, which has control of Crystal Lake and Lake Quannapowitt in Wakefield), the Board replied as follows: —

BOSTON, March 4, 1889.

In regard to the suggestion of a contract with the Wakefield Water Company for a supply from Crystal Lake and Lake Quannapowitt, the Board finds that all of the water that can be supplied in a dry year by Crystal Lake is needed by Wakefield and Stoneham, now supplied by this source, and that the large population upon the watershed of Lake Quannapowitt and the present quality of its water render it unfit for a domestic water supply.

From examinations made by the town and by the chief engineer of the Board, and having regard to the rights of other communities, and the quantity and purity of the water and the probable cost of works, the Board advises the town to seek a supply from the ground near the Ipswich River. Such source, if within the limits of the town, would be subject to whatever rights, if any, may remain to the Reading Water Company, under chapter 381 of the Acts of 1885.

The introduction of a water supply will create a more urgent need of a sewerage system, which will probably require the purification of the sewage upon land, and the discharge of the effluent either into streams in the Saugus or the Ipswich River water-

sheds. Care should be taken, in the selection of a source of water supply, to choose a locality which will not in the future be affected by the effluent from sewage disposal, or interfere with the selection of a site for such disposal.

HINSDALE. Citizens of Hinsdale having applied to the Board (Jan. 26, 1889) for its advice in relation to the taking of water from Steam Saw-mill Brook as a public supply for the proposed fire district, the Board replied as follows: —

BOSTON, Feb. 28, 1889.

The Board has examined the plans and data presented, and has had the territory about the town examined by its chief engineer, and a sample of water from the brook analyzed. From the information obtained, the Board concludes and advises that Steam Saw-mill Brook is the most appropriate source of supply for the proposed Hinsdale fire district.

With regard to the special request for advice with reference to the capacity of the proposed storage reservoir, and the depth required to produce favorable conditions for storing water, the Board transmits the advice of their chief engineer, "that the storage reservoir be made large enough to contain 35,000,000 gallons of water, and that its flowage line be lowered not more than five feet from the height shown on the plan submitted; and that, if it should prove that much water filters through the dam or the ground under it, it may be necessary to intercept the filtered water by a small dam farther down the stream, and use it as a part of the supply for Hinsdale."

It is also suggested that it would be desirable, for many reasons, to build the small dam above proposed when the works are first constructed. The advantages of this plan would be: The added security as to the amount of water which can be obtained by the interception of the tributary known as Hoose Brook, which enters the main stream below the storage reservoir; the better quality of the water to be obtained from the natural flow of Hoose Brook than from the storage reservoir; the more favorable conditions for maintaining the good quality of the water in the storage reservoir, by diminishing the amount by which it would be drawn down in a dry time; the reduction of the pressure in the pipes to an amount that would be better suited to the wants of the town than the direct pressure from the storage reservoir.

The disadvantages would be the need of an automatic regulator to keep the small reservoir filled to high-water mark with water

from the storage reservoir, whenever the water entering it from other sources was insufficient. A regulator of this kind must be one that will act without fail under all conditions; otherwise, the works might fail at some time to furnish the supply required for fire purposes.

STOCKBRIDGE. Water for domestic use is furnished to different parts of this town from different sources and by different parties. Citizens of the town having applied to the Board (Jan. 29, 1889) for its advice relative to the use of water from other sources as a supply for the main village, the Board replied as follows: —

BOSTON, March 5, 1889.

Water is now furnished to different sections of the town by three water companies. The Stockbridge Water Company, whose original works were built in 1862, furnishes water to the larger portion of the village of Stockbridge. The water furnished by this company is of good quality, but the quantity supplied is insufficient in a dry time for ordinary uses. The pressure in the pipes is so much reduced at times that the works afford no protection against fire. At other times they may furnish a limited protection, but at no time will they furnish anything approaching a suitable supply for fire purposes. The Hill Water Company, incorporated by chapter 100, Acts of 1885, takes water from sources on the westerly side of Rattlesnake Mountain in the town of Stockbridge, and is permitted by its charter to supply only the inhabitants of "The Hill" back of the village of Stockbridge. The Lenox Water Company is authorized by chapter 198 of the Acts of 1887 to distribute its water through the north-easterly portion of the town of Stockbridge, which adjoins Lenox village.

The Board has caused examinations to be made of Lake Mahkeenac, otherwise known as Stockbridge Bowl, the source specified in the application submitted; and of Mohawk Lake, otherwise known as Hagar Pond, in compliance with a subsequent verbal request of the applicants. Stockbridge Bowl has until recently received through one of its tributaries all of the sewage discharged from the village of Lenox, and still continues to receive a portion of this sewage. The water is harder than is desirable for some domestic purposes, and harder than that supplied to any town in the vicinity. In other respects the analysis of the water does not show any specially unfavorable features. The quantity of water to be obtained from this source is ample. The pressure, if a supply is taken by gravity, as now proposed, would be insufficient

for furnishing a satisfactory fire source. Mohawk Lake is almost entirely free from artificial pollution. The analysis of its water shows it to have the same undesirable degree of hardness as the water of Stockbridge Bowl. In other respects the water is better than that from the Bowl. The existing information will not permit a decision as to whether this source will furnish either a sufficient quantity of water or the requisite pressure for fire purposes.

The Board advises that it does not consider Stockbridge Bowl a suitable source of supply for Stockbridge. With regard to Mohawk Lake, no decision can now be given with reference to quantity and pressure, but the water is so hard that it is desirable to obtain a softer water, if feasible.

The Board advises that examinations be made of other sources which may be available for the supply of Stockbridge, and suggests that brooks rising in Great Barrington and Monterey, and flowing northerly into the Housatonic River at South Lee, would furnish, by gravity, a sufficient supply of water with the proper pressure to both South Lee and Stockbridge. The other sources which appear worthy of examination are: Muddy, otherwise known as Konkapot Brook, Lake Agawam, and the stream running from it into Muddy Brook and Lake Averic. Pumping would be required to take water from these sources. The Board is not informed as to the quality of water from these sources, nor whether any present use of the waters would be an insuperable objection to using any of these sources for water supply purposes.

Ludlow Manufacturing Company. This company, located in the town of Ludlow, on the Chicopee River, applied to the Board (Feb. 4, 1889) for its advice relative to the use of the water of the Chicopee River, or from Chapin's and Wood's ponds. The Board replied as follows: —

Boston, March 23, 1889.

The drainage area of the Chicopee River above Ludlow contains at present about twice as many people whose sewage may enter the streams for each thousand gallons flowing in the river as there are upon the Merrimac River above Lawrence. As sewerage systems are multiplied in this area, the amount of impurity will rapidly increase. At present there are times of high water when the analyses of the water of Chicopee River do not indicate that it is more objectionable than some other rivers used for drinking; but there are seasons of low water when the indications

of pollution are such that this Board does not regard it a suitable water to be introduced as a domestic water supply.

Looking to the rights and interests of all parties, we see that if the Ludlow Manufacturing Company should use the water of Chicopee River for domestic purposes, the towns of Ware and Palmer and the village at the Collins' Paper Mill in Wilbraham, and all others along the river or on any of its branches for twenty miles above the point of taking the water, would be obliged, by Public Statutes, chapter 80, section 96, to purify their sewage before turning it into the neighboring streams. The cost to these communities to purify their sewage would be much more than the additional cost to the Ludlow Manufacturing Company to obtain its water from other sources.

From considerations of the rights and interests of both the employees of the Ludlow Manufacturing Company who are to use the water, and all parties for twenty miles up the stream, the State Board of Health advises that the water of Chicopee River should not be introduced as a domestic water supply for the inhabitants of Ludlow.

The water of Chapin's Pond is a very soft, colorless water, of excellent quality. The water of Wood's Pond is of the same general character, but, owing to the small depth of the pond, there may be seasons when vegetable growth may make its taste unpleasant. The engineer of the Board was unable, in the time at his command, to make such examinations as would enable him to determine whether these ponds would furnish sufficient water for the village of Ludlow; and the Board advises the Ludlow Manufacturing Company to make further investigation upon this point.

From the examinations made, it appeared probable that, upon drawing water from Chapin's Pond and lowering its level, water from Wood's Pond would filter through to Chapin's Pond. If so, the water from Wood's Pond would probably, by the filtering, be relieved from any vegetable growths which might be found disagreeable if water were taken directly from Wood's Pond.

North Easton. In 1887 the water commissioners of North Easton applied for the advice of the Board as to the propriety of obtaining a public water supply from a well near one of the mill ponds on the Queset River. This source was approved by the Board (Nineteenth Annual Report, 1887, page 10), with suggestions as to a further source of supply in case the proposed source should prove insufficient. The commissioners deemed it desirable to in-

troduce a supplementary supply from Lincoln Spring, and also by filtration from Quesct River, and applied to the Board (March 1, 1889) for its advice relative to this plan. To this application the Board made the following reply : —

BOSTON, May 9, 1889.

It is proposed to draw water from the well as at present, from Lincoln Spring and from open-jointed pipes placed in the ground from five to seven feet below the bottom of a basin having an area of two and one-third acres, into which basin water can be conveyed from a mill pond on the Queset River, and maintained to a depth of six feet.

The water from the present well and that to be obtained from Lincoln Spring will probably continue to be good water. The water from Queset River, while free from pollution by sewage, is not satisfactory because of its color, and liability to objectionable vegetable organisms unless properly filtered. Such filtration is in the plan proposed expected to take place by continuous percolation of water through the material of the bottom to pipes placed five feet to seven feet below. The observations and experiments of the Board do not warrant the conclusion that such continuous filtration will permanently remove the objectionable qualities of the water, and the Board would advise: First. That the pipe from Lincoln Spring, as it passes under the basin, should be made with water-tight joints, so that the water from this spring and its vicinity may be conveyed to the pumping station independent of the questionable water to be filtered. Second. That, if water is to be brought from Queset River to the basin to be filtered, it be brought intermittently in sufficient quantity to supply the deficiency from the other sources, which for many years will probably be not more than would cover the bottom of the basin one or two inches deep per day. Let this quantity be received during six to twelve hours in a day, in a channel in the higher parts of the tract, and distributed as evenly as practicable through the area of the basin. This may be done by removing the mud from the tract and distributing the water through thirty or forty trenches, one foot wide, two feet deep, and about six feet apart, filled to within three inches from the surface with coarse sand or fine gravel. In the winter these trenches may be covered by boards to protect them from snow and frost. The Board would expect much more satisfactory results from intermittent filtration, carried on substantially as above described, than from continuous filtration from the bottom of a pond, as proposed in the plan received.

THE STATE CAMP GROUND AT FRAMINGHAM. It was deemed necessary to introduce a supply of water for the use of the troops at the camp ground in Framingham. Three sources were named in the application (made Feb. 6, 1889): Gleason's Pond, Learned's Pond, and the public water supply of Framingham, which is taken from Farm Pond; all of these sources being within the limits of the town. The two former are quite near the camp ground. The possibility of obtaining water from certain wells within the limits of the camp ground was also suggested. The Board replied to the application of the Adjutant-General as follows: —

BOSTON, March 28, 1889.

The Board reports that the water of Learned's Pond is of good quality, and is preferable to either that of Gleason's Pond or that of the Framingham water supply.

Our attention was called to the question of obtaining water from wells upon the ground of the State. Examination has been made by this Board of the water of several wells upon the camp ground, which shows that those numbered upon the plan of the camp ground from 2 to 10 inclusive are polluted and unfit for use, while No. 1 and the well at the superintendent's house afford water of good quality.

At a later date (May 10) the Adjutant-General submitted the following questions: "Would the State be as well provided with water by taking it from the South Framingham Water Company? Which would you recommend and advise, — Learned's Pond, or the water company's supply?" To which the Board replied as follows: —

MAY 15, 1889.

In a previous reply, the Board stated that the water of Learned's Pond is preferable to that of the Framingham water supply. This reply was based upon examinations of the present quality, and the probabilities of the future conditions of those supplies. The water of the South Framingham Water Company has, from monthly examinations for two years, proved to be of better quality than that of the Boston water supply, and, being drawn from the ground, it is likely to be free from the objectionable qualities that are sometimes present in the Boston water in summer; and, although the water of Learned's Pond is better than either of those named, there are considerations which may with reason have much weight in your judgment.

In reply to the second question, the water of Learned's Pond is preferable in point of quality; but there are other considerations which may present themselves, such as the question of a more sure and continuous supply of water throughout the year for fire purposes and for other uses, which would be afforded by a well-established town supply, as compared with a plant which would be used for a few days only in each year, and which would consequently in an emergency be more liable to faulty operation and consequent insecurity.

MEDFORD. The town of Medford, having considered it necessary to supplement its present supply of water from Spot Pond, applied to the Board (Feb. 19, 1889) for its advice relative to an additional water supply from the region about the southerly end of the pond, and storage of waste water from the pond. To this application the Board made the following reply: —

BOSTON, June 4, 1889.

The State Board of Health has given much time to investigating the questions which arise in considering the application for advice from the town of Medford, in regard to a proposed additional water supply. One of the conclusions reached is, that with a recurrence of dry years, such as existed between June, 1879, and February, 1886, one-third of the water supplied by Spot Pond, making full use of its storage capacity from high water to low water, will not give the present population of Medford fifty gallons per inhabitant per day. During three of these years the surface of the pond did not rise to high-water mark, and there was consequently no waste, which could have been used to supply an additional reservoir. During the other three years water rose above high-water mark, and wasted over the dam for a short time each year; but this amount was so small that if three towns, each having a population of 10,000 (which is about that of Medford to-day), were drawing fifty gallons per inhabitant per day, there would not have been enough to supply them, had all the waste been used. It is evident that a reservoir depending for its water upon the overflow from Spot Pond can be of no value to Medford in a moderately dry year in the future.

The proposed reservoir, with high-water mark as high as that of Spot Pond, made by building a dam on land purchased by the town at the site of an existing dam near an ice house, would have an independent watershed of about 160 acres; but it would flow a large area of swampy land to a small depth, so that the water

would not probably be of suitable quality for use. A reservoir at a lower level would not give sufficient pressure in the pipes in some parts of the town.

It therefore appears that the only practicable way of getting an additional supply of much value from this vicinity is by pumping. If pumping works are to be constructed, they should be located below the ice-pond dam, where, in addition to the water from the ice pond, they can take the flow of the brook coming across Elm Street from the east and the water draining from the hills on the west. The watershed would thus be increased to about 339 acres, or more than double the watershed above the ice-pond dam. With a moderate amount of storage, the quantity of water thus obtained would be a valuable addition to Medford's supply. To obtain water of satisfactory quality, it would be necessary to do a considerable amount of work upon the improvement of the watershed, by isolating the swamps so that water from the uplands cannot flow over them; by draining the swamps and carrying all streams around or through them in suitably constructed channels; and to construct a reservoir without too much shallow flowage.

The Board has not sufficient detailed information to recommend the town to obtain an additional supply in this way, but regards the prospect sufficiently favorable to warrant its investigation by the town.

Riverside Water Company. This company, located in the town of Gill on the west bank of the Connecticut River, applied to the Board (Feb. 15, 1889) for its advice relative to certain sources of supply, as an additional supply to one already in use by the company. The Board replied to their application as follows: —

Boston, March 22, 1889.

The Board has caused examinations to be made of Nevin's Brook and Barton's Cove, the proposed sources, and of Heal-all Spring, the source now supplying water to the village. It finds that the present source will furnish a sufficient quantity of water of excellent quality to supply the inhabitants of the village until it is much larger than at present. Owing to the low level of the source and the small size of the pipes, the present system of works will not furnish water at a sufficiently rapid rate or with sufficient pressure for an efficient fire service.

Although an efficient fire protection requires that water should be delivered rapidly and under a high pressure, the total quantity

of water used per year for this purpose is small; and the Board thinks that such protection can be obtained much more cheaply by some other method than by taking water from Nevin's Brook. It would suggest, as methods for obtaining such protection, a connection with the Turners Falls system of water supply, or the construction of a reservoir of suitable size on high land back of the village, to be filled with water from the hills by gravity, or from the Connecticut River by pumping; or pumping the whole volume required for a fire directly from the river, by pumps located at the mills or at an independent pumping station.

Nevin's Brook now appears to be an appropriate source for the future supply of the village of Riverside, after it outgrows the capacity of the present source, as its water is of good quality, and a much larger quantity can be obtained from it than from Heal-all Spring. Barton's Cove does not compare favorably with other sources in the neighborhood, and is not recommended as a source of supply for domestic purposes.

PROVINCETOWN. The committee on water supply of the town of Provincetown having applied to the Board (March 15, 1889) for its advice relative to obtaining a supply of water from the region lying north of the town, the Board replied as follows: —

BOSTON, April 2, 1889.

The Board advises that, from examinations made by this Board and the data furnished by the town, it appears that the territory back of Provincetown is the most appropriate source for supplying water for the town. The ponds in this territory would not furnish a suitable supply unless the water from them is properly filtered. Test wells driven in the ground furnish in some places water that would be entirely satisfactory for supplying the town; in other places the water has a very objectionable color and odor. The examinations made by the town appear to indicate that a satisfactory supply of water can be obtained from this territory by means of shallow wells at a reasonable cost; but, before constructing works, the town should cause more complete examinations to be made, to determine the best area for sinking wells, and whether the water would improve or deteriorate when large quantities are pumped. If it should be found to deteriorate, it may be necessary to resort to filtration.

IPSWICH. The town of Ipswich, through its selectmen, applied to the Board (March 16, 1889) for its advice rela-

tive to the use of the water of Hood's Pond for a public supply. The Board replied as follows: —

BOSTON, April 2, 1889.

The Board finds that Hood's Pond would furnish a sufficient quantity of water for Ipswich, of fair quality. The high color of the water of one of its main feeders indicates that at certain seasons the taste of the water may be objectionable. This condition, the distance of more than six miles from the centre of the town, and the low level of the pond from which it would be necessary to pump the water, led the Board to look for a ground water supply nearer the town. The engineer of the Board concluded from his observations that the territory west of Ipswich River, within a mile above the village, appears from surface indications to furnish favorable opportunities for obtaining water from the ground, which would probably be of better quality than that from Hood's Pond; and the Board would advise the town of Ipswich to seek to obtain a ground water supply from this territory, before deciding to take water from Hood's Pond.

NEWTON. The city of Newton, through their engineer, submitted to the Board an application (April 8, 1889) for its advice relative to an additional supply of water from the region lying near the Charles River above that city; and the Board replied as follows: —

BOSTON, May 9, 1889.

The Board has considered the application of the city of Newton for advice, and approved of a plan for a proposed additional water supply, which is to be taken from the ground on either side of Charles River from the Needham Street bridge southerly to the line between Newton and Boston, and taken from Charles River to an amount not exceeding 5,000,000 gallons per day.

This application was received April 10, 1889, more than two months after the subject had been referred by the Legislature to its committee on water supply, and but five days before they reported a bill. An investigation of the subject was immediately commenced by officers of the Board, and the following conclusions are reached: —

Considering the interests of Newton alone, the scheme proposed appears to be a very good one for obtaining more water and maintaining the purity of the supply, if all of the supply be drawn from the ground. In considering the interests of other towns and corporations which may be affected, questions arise whether Needham

or Brookline may not find portions of this territory their most appropriate sources of supply, and whether the 5,000,000 gallons proposed to be taken is not more than Newton's proper proportion of the water of Charles River, whose diversion in addition to that diverted by other towns may not injuriously affect the rights of those down the river who use the water or live on the banks of the stream.

From such examination as the Board has made, it appears probable that both Brookline and Needham can get their share of ground water from this valley above the Newton line. If, however, further investigation should show the area up the valley to be less suitable for this purpose, it would be reasonable that Needham should have a share in the territory within the limits of the town where Newton now proposes to select area for its supply; and the Board advises Newton to leave the up-stream portion of the proposed area on the Needham side of the river unused until the needs and sources of supply for Brookline and Needham are more fully determined.

In regard to the limit of 5,000,000 gallons, the Board would advise that the measurements of flow in the Sudbury River during very dry years indicate that there are likely to be seasons in such years when the quantities of water previously granted to cities and towns along the river cannot be supplied if Newton then takes the full amount proposed, and consequently that there are likely to be seasons when Newton cannot depend upon receiving 5,000,000 gallons from this source.

DRACUT. Prentiss Webster, Esq., in behalf of the Dracut Water Supply Company, having applied to the Board (May 17, 1889) for its advice relative to the use of the water of Beaver Brook and other sources in Dracut as a water supply for that town, the Board replied as follows:—

BOSTON, May 24, 1889.

The State Board of Health has considered your application for advice with reference to supplying the town of Dracut with water from Beaver Brook in the town of Dracut above the paper mills of Parker and Bassett, and from springs and wells in the same vicinity. It finds that the water of Beaver Brook is so much polluted — both artificially by the refuse from the Collins Woollen Mill about two miles above the paper mill, and naturally by the vegetable matter which gives the water its dark color — that it is an unfit source for supplying water for domestic purposes. The springs

near the mill would probably furnish water of excellent quality in sufficient quantity for supplying a small number of families, though inadequate for the supply of the town of Dracut.

The Board would therefore advise that, if you desire to provide a supply for the whole town or any large portion of it, you should seek some source of supply not included in your present application to the Board. The time within which the Board understands that you desire an answer to the application, as presented to the Board, does not admit of a more extended examination, in order to advise you where to seek for such other source.

North Brookfield. A committee of the town of North Brookfield having applied for the advice of the Board (May 22, 1889) relative to certain proposed sources of water supply in that town, the Board replied as follows: —

Boston, May 23, 1889.

Your application of yesterday to the State Board of Health for advice in regard to a source of water supply for the town has been considered with as much fulness as practicable in the time at disposal. The engineer of the Board has hastily examined the sources you have proposed. The springs just north of the village, or one or more wells located in their vicinity, would supply too small a quantity of water to be regarded as an adequate supply for the village; and with such wells it is probable that the water would become polluted from the number of dwellings within the territory that would be drained.

The water of Horse Pond and of Horse Pond Brook, owing to contact with swamps, does not appear at present to be of a quality that would be entirely satisfactory if taken directly to the village; but it may be that water of satisfactory quality can be obtained from the ground by means of wells or otherwise in the valley near the brook. To obtain sufficient water in this way, it is advisable to seek a location as far down the brook as Batchelder's Pond. From present information, the Board would advise thus seeking a supply for the town.

Attleborough Fire District. The Attleborough Fire District Association requested the advice of the Board upon the following points: 1. Whether the presence of certain vaults and cesspools are a source of contamination of the water supply; 2. Whether an increased supply of water could be obtained from the present source by driving more

wells in the vicinity; 3. Whether water can be taken from the river or the wells, and purified by any system of filtration.

To these inquiries the Board made the following reply: —

BOSTON, June 4, 1889.

The State Board of Health has carefully considered the three questions contained in your application for advice of May 6, and finds as follows: —

1. Chemical examinations of water from your well uniformly indicate that this water has been polluted by sewage, and a part of this pollution has been filtered out by passing through the ground. The most apparent sources of such pollution are the privies in the vicinity, and privies and drainage in the larger area supplying the wells.

2. It is doubtful if any material increase in the quantity of water can be obtained in the vicinity of the present well; but if the effort were made, and the water in the ground were held at a lower level, the result would be the enlargement of the basin thus drained to include a larger number of privies and drains, and the consequent increase in pollution of the water. It is not, in the judgment of this Board, advisable to seek an increased supply at this point.

3. To your third question, "If water could be taken from the river or our wells, and purified by any system of filtration," this Board knows of no system of rapid filtration which will make water which has been polluted by sewage suitable for drinking. The water from the well or from the river may have nearly all, and perhaps all, of the objectionable impurities removed by slow intermittent filtration through a large area of sand; but the expense of such treatment would probably be greater and the result less satisfactory than to obtain a supply from the ground from some source which is not polluted by sewage; and the Board would advise your seeking such a source before attempting filtration of water from your present well or from the river.

BRADFORD. The Bradford Aqueduct Company applied to the Board for its advice (June 19, 1889) relative to the use of water from wells upon the bank of the Merrimac River, or from wells on Porter's Island in the same river, as a source of public water supply. The Board replied to the application as follows: —

BOSTON, Aug. 6, 1889.

From investigations made by the Aqueduct Company, by sinking a well near the Bradford bank of the river, we understand

that the supply to be obtained there is limited, and in the present condition of this well a sample would not enable us to determine the quality of water which may be obtained from it. Water taken directly from the river at this place would be unfit for a domestic water supply.

From examinations on Porter's Island it would appear that wells one hundred feet from the river, with no communication with the river except by percolation through one hundred feet or more of sand and gravel, would probably give a good water supply for the town; but this is only to be determined by trial.

A driven well, a short distance from the main well which you are sinking, shows water of a very good quality. Whether the water will continue as good when a larger quantity is drawn through the ground, or whether the quantity will be sufficient at first or continue so after long pumping, can only be determined by trial; but, after the expenditure already made, the present indications, in the opinion of the Board, render advisable the completion of the well, and a long-continued trial by pumping, when the quantity as well as the quality then existing may be definitely determined.

Andover. The water commissioners of Andover applied to the Board (June 19, 1889) for its advice in regard to the water of Haggett's Pond in Andover as a public water supply. To this application the Board replied as follows: —

Boston, July 23, 1889.

The Board, having examined the territory to which the town is limited by chapter 437 of the Acts of 1887 for such source, finds the water of Haggett's Pond to be of good quality and abundant in quantity. The appearance of vegetable growths near the inlets of the dark-colored brooks which flow into the pond, and the finding of objectionable microscopic organisms in the water at a considerable distance from the shore, indicate to the Board that seasons are likely to occur when the water will have a disagreeable taste and odor. To guard against this probable objection, the Board would advise the town to make the necessary borings and examinations to ascertain if a large bed of open sand or gravel cannot be found on the southerly or easterly side of the pond below the level of the water, from which water may be pumped in sufficient quantity to supply the town, after it has filtered about one hundred feet from the pond. This arrangement would insure an excellent supply of water for the town, if the further precaution be taken of having the water which is stored kept from the light.

Lenox. The Lenox Water Company applied to the Board (Aug. 1, 1889) for its advice relative to the water of Roaring Brook in the town of Washington as a public water supply. The Board made the following reply: —

Boston, Sept. 11, 1889.

The Board finds that Roaring Brook, at a point where its waters might be diverted, could furnish a sufficient quantity of water for supplying Lenox; but that the water is so deeply tinged, and is shown by analysis to contain so much organic matter, that in the opinion of the Board this is not the most appropriate supply for Lenox. About three miles south of Roaring Brook is Basin Pond Brook, which also rises in the town of Washington and empties into the Housatonic River a short distance south of Lenox Dale. A preliminary examination indicates that the natural flow of this brook would furnish by gravity a sufficient quantity of water for Lenox, and that the length of pipe required would be no greater than for a supply from Roaring Brook. The water of Basin Pond Brook is soft and has considerable color, but less than one-third as much color as the water of Roaring Brook. No analysis has been made to determine the amount of organic matter in this water.

The Board advises the Lenox Water Company that Basin Pond Brook is much to be preferred as a source of water supply for Lenox to Roaring Brook, and that it is probably the best source from which to obtain by gravity a supply of water for Lenox. The Board calls your attention to this source as preferable to the one you have presented, but is not, however, at present prepared to advise that it is the best source of water supply for Lenox, nor as to whether it is the most appropriate source for Lenox, having due regard to the rights of the town of Lee.

Springfield. The water supply of the city of Springfield, obtained from a watershed in the towns of Ludlow and Belchertown, and collected into a large storage reservoir in Ludlow, has proved offensive to consumers through a part of each year since its introduction, in consequence of bad odor and bad taste, the principal complaint from such causes occurring in the summer and autumn. The water commissioners, being desirous of improving the quality of the water, applied to the State Board of Health for advice (March 29, 1889); and the Board, after an extended investigation, occupying several months, submitted the fol-

lowing reply, which is accompanied with the reports of the engineer, the chemist and the biologist: —

Office of State Board of Health,
13 Beacon Street, Boston, Sept. 13, 1889.

To the Water Commissioners of Springfield.

Gentlemen: — The State Board of Health herewith presents the reports of its experts, Mr. F. P. Stearns, chief engineer; Prof. T. M. Drown, chemist; and Mr. G. H. Parker, consulting biologist, — giving the results of their researches up to the present time, concerning the cause of the unpleasant taste and odor of the water supplied to Springfield, and concerning possible methods of improving the water supply.

In the summer the trouble is attributable to the presence in Ludlow reservoir of an enormous growth of blue-green algæ, and a considerable growth of green algæ. In the winter of 1888 the trouble occurred when the animal organism *dinobryon* was most abundant, and this is its probable cause.

The data at command give no indication that natural causes will bring about an improvement of the water of Ludlow reservoir. Certain methods which may to some degree improve the water in the reservoir are given in the report of the chief engineer, and various schemes for improving the water after it has left the reservoir are considered. The Board has not yet learned of any mechanical filters used with alum as a coagulant, that it is ready to recommend for removing the objectionable qualities of this water, so that it may be used with safety for drinking.

The method of intermittent filtration upon fifteen or twenty acres of land, as presented by Mr. Stearns, is one which the Board regards so favorably that it would advise you to have it carefully investigated and elaborated by a competent engineer, before spending money in other directions.

Report of the Engineer of the Board.

Office of State Board of Health,
13 Beacon Street.

To H. P. Walcott, M.D., *Chairman State Board of Health.*

Sir: — Herewith is submitted a report with reference to improving the quality of the water supplied to the city of Springfield.

REPORT.

An application dated March 29, 1889, was made by the Board of Water Commissioners of Springfield, requesting the advice of this Board as to the best practicable method of improving the quality of the water

supplied to the city of Springfield. Advice was particularly asked in the application with reference to a suggested method of improving the quality of the water in the reservoir, and with reference to filtering the water. Many other suggestions have since been presented verbally by the water commissioners and other officials of the city; and I will consider most of these in my report.

The population of Springfield from 1865 to 1885 has been as follows: —

1865,	22,035	1880,	33,340
1870,	26,703	1885,	37,575
1875,	31,053		

The present population is estimated to be about 41,000. The consumption of water is stated in the last report to be about 4,000,000 gallons per day, equal to 97 gallons per capita.

The water supply of Springfield is taken from a storage reservoir located in the town of Ludlow. When full, this reservoir has an area of 445 acres, contains 1,992,000,000 gallons, and its average depth is 13.7 feet. The character of the area covered by the reservoir is described in much detail in the report of the Springfield Water Commissioners for 1875, pages 41 and 52. Of the area flowed by the reservoir, 281 acres were covered with wood in various stages of growth, a part of which was low, swampy land, the mud or peaty deposit ranging from 6 inches to 4 feet in depth. These peaty areas are not less than 12 feet below high-water mark, and most of them are as much as 16 feet below. The stumps were cut low, and all wood and brush was burned, and the stumps were charred. Six and three-eighths acres of the most objectionable portion of the swamp were sanded over to a depth of nearly 1.5 feet. The shores to a depth of at least 12 feet are, as a rule, abrupt. A comparatively small area near the upper end of the reservoir is an exception to this rule, the water being quite shallow. The filling of the reservoir began in 1874, and in 1875 water was turned into the city. The trouble with the quality of the water began in the summer of the latter year, before any water was turned in from the Belchertown reservoir. This fact is mentioned because this reservoir, which will be described subsequently, has sometimes been considered to be the original cause of the trouble in the Ludlow reservoir.

In December, 1875, and January, 1876, the water of the reservoir was examined by Prof. Wm. Ripley Nichols, who, at this season of the year when the summer trouble had passed away, discovered nothing very unusual in the chemical analysis, except that the free ammonia was high, — as much as .0162 parts per 100,000 in some samples. During the summers of 1876 and 1877 the water was examined weekly by Professor Nichols, and showed the peculiar characteristics which are now shown by the examinations of the State Board of Health.

The Ludlow reservoir is fed by a direct watershed of 1,188 acres, exclusive of the reservoir. On the west it receives water from Higher Brook through a canal about one mile in length. The watershed of

Higher Brook at the point where its water is diverted is 1,119 acres. On the easterly side, water is brought into the reservoir by the Broad Brook canal, about 12,000 feet long. Until Nov. 30, 1886, this canal brought water from the Belchertown reservoir, which is a shallow body of water covering about 25 or 30 acres, and flooding, in addition, to a very small depth, a large area of swampy land along Broad Brook above the reservoir. As it was thought that the water from this reservoir and the swampy land above it had an injurious effect upon the water in the Ludlow reservoir, the canal was extended and altered so as to intercept only the north-western branch of Broad Brook, which is locally known as the Axe-factory Brook,— the water in the Belchertown reservoir being allowed to run to waste. The area of the Axe-factory Brook watershed at the point of diversion is about 1,655 acres. The watersheds now and formerly tributary to the Ludlow reservoir, as determined from the Springfield water works' map of the watershed, with modifications to suit present conditions, are as follows: —

Direct watershed,		1,188 acres
Higher Brook watershed,	1,119 acres	
Axe-factory Brook watershed,	1,655 acres	
Watershed intercepted by Broad Brook canal,	396 acres	
Total indirect watershed,		3,170 acres
Total watershed now used,		4,358 acres
Watershed of Belchertown reservoir, excluding Axe-factory Brook,		2,126 acres
Total watershed used previous to Nov. 30, 1886,		6,484 acres

If all of the water draining from the watersheds now in use found its way into the reservoir, the latter could be depended upon to furnish 800,000 gallons per square mile per day through a series of dry years, equal to a total of 5,450,000 gallons per day. Since, however, some water is lost by filtration from the canals, and some probably wastes in times of freshets on account of the inability of the canals to carry the whole volume, I should consider 700,000 gallons per day per square mile from the indirect watersheds as the most that could be depended upon. This would make the total yield of the reservoir 4,950,000 gallons per day. The contents of the reservoir would equal 404 days' supply, at this rate.

Water is conveyed to the city through ten and two-thirds miles of twenty-four inch cement-lined wrought-iron pipe. The higher districts are supplied directly from the Ludlow reservoir. The lower districts are supplied chiefly with Ludlow water, which is turned into two distributing reservoirs known as the Van Horn and Lombard. The Van Horn reservoir has a considerable watershed of its own, mostly, an elevated sandy plain from which much of the water enters the reservoir by filtration through the ground. The Ludlow water is supplied to this reservoir through an eight-inch pipe, which ends at a ditch in the elevated sandy plain beside the reservoir. The water is allowed to flow through this ditch for about five hundred feet, and then flows swiftly through a trough having a steep grade, and at the end falls about ten feet.

In examining a series of chemical analyses of the water of Ludlow reservoir, the most noticeable feature is the large fluctuation in the amount of albuminoid ammonia at different seasons of the year. During the winter and spring the amount of this kind of ammonia is generally about the same as is commonly found in the reservoirs and ponds in the State; but between May or June and November there is a very large rise in it, culminating in August or September. This large increase in the amount of albuminoid ammonia is due almost wholly to the presence of abundant growths of algæ and other organisms, which produce the disagreeable tastes and odors complained of.

The State Board of Health has caused chemical examinations to be made for one or more years of about seventy-four ponds and storage reservoirs in the State. Out of this number there are two storage reservoirs — one at Brockton and one at Leominster, in addition to that at Ludlow — which undergo similar changes at the same time of year; also a natural pond (Jamaica Pond in Boston), which went through even greater changes during the past year. The changes in this case, however, are different, as the rise in albuminoid ammonia culminated late in the spring. No other ponds or storage reservoirs in the State are affected by nearly as marked changes as those referred to.

In comparing the microscopic examinations of the three storage reservoirs and the pond above mentioned, it is noticeable that the microscopic growth found most abundantly in the pond is absent from the reservoirs. In comparing the three reservoirs with each other, it is found that some forms of blue-green algæ are present in each in large numbers during the season of the year when the chief trouble occurs. By extending the comparison to other ponds and reservoirs in the State, it is noticeable that, although these blue-green algæ are found in a number of places, they do not occur nearly as abundantly in any other place as in the three reservoirs specified. This seems to be a sufficient reason for concluding that the chief trouble with the Ludlow water in the summer and autumn has been caused by the blue-green algæ.

There are four methods to be considered with reference to supplying better water to the inhabitants of Springfield: —

1. By improving the Quality of the Water in the Reservoir.
2. By turning the Streams now feeding the Reservoir directly into the Main Pipe.
3. By improving the Quality of the water as it passes from the Reservoir to the Consumer.
4. By the Substitution of a Better Water from a New Source.

1. By improving the Quality of the Water in the Reservoir.

The objectionable qualities of the water in this reservoir being caused almost wholly by the organisms growing in it, it is obvious that to remedy the trouble these organisms must be prevented from growing in such abundance as to cause trouble. It might naturally be expected, that, by comparing the three reservoirs and the pond which are affected

by abundant growths of algæ with other reservoirs and ponds not so affected, there would be certain features found only in the former, or in the drainage areas from which they derive their water, that might account for these growths; this, however, does not appear to be the case.

The Ludlow reservoir has some unfavorable features. At its upper end there are shallow places, and in the bottom there are many stumps and considerable swamp land. In making comparisons, however, it is found that in very many reservoirs which do not give serious trouble these unfavorable features are found in a more marked degree, and that in some ponds and reservoirs which do give serious trouble these unfavorable conditions are absent or less marked. In view of these results, it cannot be predicted that any improvement of the reservoir in the direction mentioned would result in any radical improvement of the water.

It may next be asked whether this trouble in the reservoir may be expected to cease of its own accord. With regard to this, the most important information is the record of the Springfield works. It is known that the water has been affected with bad tastes and odors ever since the reservoir has been in use. A comparison of the chemical examinations made the last three years with those made by Prof. Wm. Ripley Nichols in 1876 and 1877, show that the trouble is as great now as it was then. The examinations of the Leominster and Brockton reservoirs extend over the past three seasons. In both cases the growth has occurred annually; in the former case the amount has varied little from year to year, while in the latter the amount has decreased considerably.

I do not know of any series of chemical analyses, in addition to those already mentioned, of water affected in the same way as that in the Ludlow reservoir. It is well known, however, that the same blue-green algæ which cause the trouble at Springfield have also caused some trouble in other reservoirs, and have subsequently almost wholly disappeared. These facts, taken together, indicate that, while it is possible that the growths in the reservoir may cease or greatly diminish any year, there is no reason to expect such a change soon from natural causes.

Considering in a more general way the conditions which favor the growth of algæ, and particularly of the blue-green algæ, I find from the statements of the biologists that they need for physical conditions to be in water of a suitable temperature, and to be where they can receive the light. They also need for food, in addition to some other things, nitrogen and carbon in some suitable form, and water. There is no doubt that these growths would cease if the reservoir could be covered over so as to exclude the light; but this is obviously impracticable. The temperature of the water in the main body of the reservoir varies from about sixty-four degrees F., June 1, to an average of about seventy-four degrees during the month of August. At these temperatures the blue-green algæ flourish in abundance. In the shallow portions of the reservoir the temperature of the water is considerably higher on hot,

sunny days, — a circumstance which may still further favor the growth of the algæ in these places. It is evident, however, that isolation or removal of the comparatively small areas of shallow flowage found in the Ludlow reservoir would not sensibly change the temperature of the main body of water, and in this way make the conditions more unfavorable for the growth of algæ; and, since the algæ thrive in the deep parts of the reservoir, the shallow portions cannot be looked upon as the only breeding places, whose elimination would lead us to expect a radical improvement in the quality of the water. The removal of the shallow flowage would improve the reservoir, but I could not recommend it without knowing the cost, so as to compare it with the probable benefits to be derived. With reference to reducing the number of algæ by diminishing the supply of food, I will refer only to the supply of nitrogen, which is one of the important elements in their structure. Estimating the amount of nitrogen as it is given by the usual chemical analysis, it is noticeable that the water during the height of the trouble in the summer contains three times as much nitrogen in a given quantity as it does in the winter, and fully three times as much as the water contains as it flows into the reservoir from the various feeders. If the additional nitrogen found in the reservoir water cannot be obtained from the air, — and it is not thought that it can be, — it must come from the bottom of the reservoir. The organisms grow in the summer, and late in the autumn they drop to the bottom of the reservoir, carrying down with them the nitrogen which may serve as food for a new crop of algæ the next season. If the reservoir had no inlet or outlet, this process might go on indefinitely without exhausting the supply of nitrogen; but under the existing conditions, with the water which flows to the city in summer carrying away three times as much nitrogen per gallon as the feeders bring in, it seems probable that the supply may some time be exhausted. Any reasoning as theoretical as this, is to be used as a guide only in the absence of practical knowledge; but, in the absence of the latter, I would recommend, with the view of reducing the food of the algæ, that as much water be fed to the reservoir as possible at all seasons of the year, unless it should be found subsequently at any time that the water of some feeder contained more nitrogen than the water in the reservoir; that only the necessary wastes be permitted in the winter and spring, when the water in the reservoir is in its best condition; and that as much water as can be spared be wasted during the summer, when the water is in its worst condition.

The suggestion has been made that it would be a desirable thing to empty the reservoir, and to remove from the bottom the deposits formed there, which consist in part of living organisms. This would undoubtedly be desirable, if it could easily be done; but it cannot be, as it would take a long time to empty the reservoir and clean it, and a large part of a year to fill it again. It would not only involve a large expense for cleaning, but would require pumping or other extensive works to be established and maintained, for supplying the city while the reservoir was empty. After this expense, it is not at all certain that the quality of water would be good, though it is probable that it would be better

than before. The exposure of the bottom during the winter to the action of frost might have a beneficial effect.

My general conclusions as to the improvement of water in the reservoir are, that we have not sufficient knowledge to enable us to recommend with confidence any scheme for radically improving the quality of the water in the reservoir; and, as the water has nearly the same character now that it had fourteen years ago, it seems very doubtful if it will soon improve of its own accord.

2. By turning the Streams now feeding the Reservoir directly into the Main Pipe.

It has been suggested that, for the purpose of emptying the reservoir and for improving the quality of the water going to the city, the water from the canals and the brook at the head of the reservoir might be conducted directly to the main pipe leading to the city. This arrangement would be advantageous, provided the water from these different sources is of satisfactory quality, and better than that in the reservoir.

No analyses have been made of the stream entering at the head of the reservoir. Analyses of the water taken from the Higher and Broad Brook canals in April, May and June, 1889, show the water to be of fair quality, with a color varying from 0.35 to 0.8.* From these analyses I am of opinion that the water of these feeders is so much better than that in the reservoir that it would be considered satisfactory. While it would be an advantage if these brooks were connected with the main pipe, it is doubtful if the advantage would be sufficient to warrant the large outlay required. In the case of Higher Brook the matter is worthy of consideration, as this can be more readily connected with the main pipe than the others; and not only would the quality of the water going to the city be improved by such connection, by an amount depending upon the quantity flowing in the brook, but it would render available the summer flow of the brook, which is now lost to a large extent by filtration from the canal. It has been suggested that the Broad Brook canal might be extended farther up the valley of the brook, beyond the Belchertown reservoir; but, if this was done, and all the brooks in the watershed controlled by Springfield were connected with the main leading to the city, the supply would be so small during the summer months that it would still be necessary to draw water from the reservoir. The greatest advantage in extending the canal up the Broad Brook valley would be, that more water could be turned into the reservoir, causing the water in it to be changed more frequently. Such a canal will ultimately be needed, to increase the capacity of this source. It would be of some advantage if water from 1,459 acres of watershed on the north-west branch of Broad Brook were turned by a short canal directly into the upper end of the reservoir.

* The scale of color adopted by the Board is one in which the color of a given water is expressed by numbers which increase with the amount of color. Water having a color of 1.0 is a decided yellowish brown, when seen in small quantity. As a standard for comparison, the color of Cochituate water in Boston is usually about 0.35.

3. By improving the Quality of the Water as it passes from the Reservoir to the Consumer.

Under this head may be considered: —

(a) *A Filter Gallery near the Reservoir.*
(b) *Mechanical Filtration with Chemicals.*
(c) *Mechanical Filtration without Chemicals.*
(d) *Continuous Filtration, as commonly practised in Europe.*
(e) *Intermittent Filtration upon a Large Area of Land.*

(a) *A Filter Gallery near the Reservoir.*

The shores of the reservoir are generally of such a character that the collection of water by a filter gallery or by wells is out of the question. There is, however, a tongue of sandy land near the gate house, about seventeen hundred feet long by about two hundred feet wide, rising to about twenty or thirty feet above high water. A test was made in 1882, to ascertain the feasibility of a scheme of natural filtration here. A pit was dug on the westerly shore of the pond, thirty-two feet long, eight feet wide, and about nine feet below the water level. The material was found to be fine gravel and sand. Four months after the pit was dug and had been allowed to fill up with water, a pump was started, and the pit was pumped out twice in twenty-four hours for about two weeks. Near the end of this test the water rose in the pit, when empty, about one foot in thirty-four minutes, or at the rate of eighty-one thousand gallons per day. Water would have to be furnished at fifty times this rate; and, when it is considered that even this amount was only obtained when the water in the reservoir was nearly at high-water mark and the water in the pit seven or eight feet below it, it seems extremely doubtful if it would be possible to get a sufficient supply by this method.

A scheme of filtration was then proposed by building a brick gallery with open joints beneath the bed of the reservoir near the shore, and surrounding the masonry with one foot of coarse gravel, covered with not less than four feet of sand. This would have admitted the water more rapidly than a natural filter, and would probably have furnished a sufficient quantity of water; but, judged by the information in the possession of the Board as a result of its recent investigations of the water supplies of the State, this water, in addition to being imperfectly filtered, would have contained an abundant growth of crenothrix, an organism which will grow in the pipes when the conditions are favorable, as it does not require the presence of light.

(b) *Mechanical Filtration with Chemicals.*

Tests made by filtering water from the Brockton reservoir through a coarse-grained sand, using alum as the chemical, showed that nearly all the color, algæ and bacteria could be removed from the water by the use of a sufficient quantity of alum, but some of the constituents of the alum passed through with the filtered water. The Springfield water has much less color than that at Brockton, and the amount of chemical required might consequently be less. The pressure required to operate the filters, and for any further treatment of the water to remove the

tastes and odor, would diminish the head in the city, making a new pipe from the reservoir even more necessary than under present circumstances. The effect upon health of water filtered in this way does not come within the province of the engineer.

(c) *Mechanical Filtration without Chemicals.*

A few experiments on filtration through sand, at the rate usually adopted with mechanical filters, show unsatisfactory results. The effect of filtering at a much slower rate through a mechanical filter, which can be readily washed, has not, so far as I know, been tried; but, as such filtration would require filters of much larger area or a much larger number of filters, this method would be prohibitive, on account of cost, unless a much cheaper filter can be constructed. In the absence of experimental knowledge of any satisfactory results with this kind of filtration, I should not advise it.

(d) *Continuous Filtration, as commonly practised in Europe.*

This is a method by which water is filtered continuously downward, through artificial filter beds made of layers of sand and gravel. Each layer is composed of sand or gravel of nearly uniform grain, arranged with the finer material at the top. The speed of filtration by this method would not be more than one-sixtieth as great as is the common practice with mechanical filters, but would be from ten to fifteen times as fast as the scheme of intermittent filtration proposed below. With continuous filtration at the rate here mentioned, the water would be much improved, though it is doubtful if the quality of the filtered water would be entirely satisfactory. This scheme would be costly in the beginning, and would be expensive to maintain; since, with continuous filtration, the surface of the sand would become clogged with the algæ, and would require frequent cleaning.

(e) *Intermittent Filtration upon a Large Area of Land.*

In the mechanical filters already referred to, the water is passed through the filter with such speed that the whole operation is performed in a few minutes. This rate is necessary, as a reduction of speed means a correspondingly increased plant, and with very slow filtration the cost of the plant would be prohibitive.

Where suitable gravelly or sandy land is available, which can be used for filtration in its natural state after a moderate expenditure for preparing the surface, it may be feasible to provide so large an area that the water will be hours or even days passing through the filter. Under these circumstances, the water in passing through the ground undergoes a distinct chemical change, becoming in all respects like spring water.

The purification of the sewage of cities by filtration, in accordance with the method here suggested, has been tried with successful results. The purification of water has been tried on an experimental scale by the State Board of Health at Lawrence, Mass., for nearly two years, and satisfactory results have been obtained when the water was filtered at the rate of three hundred thousand gallons per acre per day. These

results were obtained with Merrimac River water, and it has not been necessary to clean the filters during the whole time, since, owing to the intervals of rest between the applications of water, the suspended organic matters filtered out have disappeared from natural causes. It may be that, with the Springfield water, when it contains a large number of algæ, it would be necessary to give a longer interval of rest, which would diminish somewhat the quantity that could be applied per acre. Any peculiarity of the Springfield water in this respect could be determined by an experiment, which could readily be made at any suitable place on the plain, as, for instance, near the Van Horn reservoir. It would be well to prepare as a filter a definite area of say one-twentieth of an acre, by removing the soil from it, and apply to it a measured quantity of water each day.

A system of filtration of this kind can only be recommended for Springfield, if further examinations show that a sufficient area of land, consisting of gravel or sand to a considerable depth, can be obtained where it is feasible to collect the water after filtration without much loss, by means of a collecting gallery or galleries.

The conditions above enumerated do not appear to exist near the Ludlow reservoir, but the surface indications are favorable for finding them somewhere on the plain between Indian Orchard and the city, not very far from the line of main pipe from the Ludlow reservoir.

The general features of a scheme of filtration of this kind would be as follows: The main from the reservoir to the city would be provided with a gate near the proposed filtration area. From the side of the gate towards the reservoir a branch would be carried to the filtration area. Here the water would be distributed over the land, filtered, collected, and conveyed to a pumping station, where it would be forced into the main leading to the city, or into a standpipe connected with the main. It would be an advantage to have the pumping station connected by an independent suction pipe with a pond containing good water, which might be drawn upon in case of fire or other emergency, if the filter did not yield water rapidly enough. A scheme of this kind would substitute pumping for gravity, and would consequently add materially to the annual cost of maintaining the works. In addition to this there would be the cost of the land and its preparation for filtration, the works for collecting the filtered water, and, if existing ponds were interfered with, there might be further cost for water rights affected. On the other hand, the pipe from the Ludlow reservoir to the filtration area would have its capacity more than doubled if the water was allowed to flow freely from the lower end, so that a large expenditure now contemplated for additional pipe from the Ludlow reservoir as far as to the filtration area would be avoided. I would recommend that this scheme of purifying the water from the Ludlow reservoir be given careful consideration.

4. The Substitution of a Better Water from a New Source.

This subject was not mentioned in the original application of the city of Springfield, but has been referred to since. I will only refer briefly

to this method of obtaining a better water, as the subject can only be properly discussed after much more extended examinations have been made than it is feasible for me to make. The large streams near Springfield, including the Connecticut, Chicopee and Westfield rivers, receive too much sewage to make them desirable as sources of water supply; and, in addition, the Connecticut contains much silt in times of freshet. The other sources mentioned are the Westfield Little River, brooks near Burcham's bend on the Chicopee River, and Jabish Brook.

The latter source, at a point where it might be taken, has a drainage area of about 10.9 square miles. It is suggested that the water of this brook might be intercepted by extending the Broad Brook canal from its present terminus at Axe-factory Brook. With this additional supply, and a pipe laid from the lower terminus of the Broad Brook canal to the main leading to this city, it has been thought that the natural yield of the Broad and Jabish brooks watersheds would be sufficient to supply the city, without drawing from the reservoir. This may be the case in ordinary seasons; but I am of the opinion that in dry seasons some water would have to be drawn from the Ludlow reservoir, even if all water intercepted was brought to the main. When water is conveyed in a canal, a greater or less amount is lost by filtration.

To carry out this scheme, legislative action would be needed, and a considerable expenditure would be required for the necessary works and for water damages. This scheme is worthy of serious consideration; but its advantages would be much more obvious, as compared with the scheme for taking water from the Westfield Little River or some other source, if the pipe connecting the Ludlow reservoir with the city was larger.

Several streams and ponds near the city, having small watersheds, or combinations of streams, have been mentioned as sources of supply. I think it very doubtful if a sufficient quantity of water of satisfactory quality could be obtained from any of the sources mentioned, though it is possible that a sufficient supply might be obtained, if the natural yield of such of these sources as supply water of satisfactory quality was augmented by filtering water from the Ludlow reservoir. There are other streams which I have not heard mentioned, and have not examined, such as the north and south branches of Mill River, which might furnish a sufficient quantity of water. I am not informed as to the character of this water, or as to the feasibility of obtaining a supply from such sources by natural filtration.

Conclusions.

The bad odor and taste of the Springfield water during the summer and autumn are caused chiefly by the growth and decay in the Ludlow reservoir of several species of blue-green algæ, which are present in great abundance during these portions of the year. The fact that the trouble in the Ludlow reservoir is shown by chemical analysis to be as great now as it was thirteen years ago, together with the experience with other reservoirs, indicate that many years may elapse before the reservoir will cease of its own accord to give trouble.

The Ludlow reservoir has some unfavorable features, such as the shallow flowage at the head of the reservoir, the swampy material in the bottom, and the large number of stumps which were not removed. In making comparisons, however, with other reservoirs and ponds in the State, it is found that very many reservoirs which do not give serious trouble have these unfavorable features in a more marked degree; and that, in some ponds and reservoirs which do give serious trouble, these unfavorable conditions are absent or less marked. This comparison, therefore, fails to reveal the cause of the trouble. The removal of the shallow flowage by excavating and filling, or its complete isolation by diking, would be beneficial; but there is no reason to think that it would stop the growth of the algæ, which cause the bad taste and odor.

Emptying the reservoir during the summer months, with subsequent cleaning of the bottom and exposure to frost during the winter, would probably cause a marked improvement in the quality of the water; and it would be an experiment worth trying, if it could be done at a reasonable expense. In view, however, of the great cost of obtaining a temporary supply from some other source, and the uncertainty as to the results, I would not advise emptying the reservoir.

With regard to the management of the Ludlow reservoir, I would advise turning into it as much water as possible from Higher and Axe-factory brooks during all seasons of the year, unless subsequent analyses should show for any time that the water of either of these feeders contained more nitrogen than the water in the reservoir. During the winter and spring, when the water is in its best condition, the reservoir should be kept as full as possible; but late in the summer, when it is in its worst condition, as much water should be wasted from it as can safely be spared. While this rule appears from present knowledge to be the best one to follow, it should be subject to such modification as further experience may suggest.

The connection of the feeders of the reservoir directly with the main pipe leading to the city would improve the quality of the water during the summer and autumn. It would not be a radical cure, however, as, during ordinary seasons, a large portion of the supply would have to be drawn from the reservoir. A partial remedy of this kind would be unsatisfactory.

I am of opinion that the conditions existing near the reservoir will not permit a sufficient quantity of water for supplying Springfield to be collected by means of filter galleries or wells on the shore. I would not advise continuous filtration through filter beds, as commonly practised in Europe. By the filtration of water through sand, using alum as a coagulant, very nearly all suspended matter and color can be removed from the water. I have had no experience as to the subsequent removal of taste and odor by aeration or otherwise. My present information as to the cost of filtration of this character, and as to the effect of water filtered in this way upon the health, is insufficient to enable me to make any definite recommendations in regard to this method.

Intermittent filtration at a very slow rate, through a large area of porous land, would furnish water of excellent quality; and it seems prob-

able that a scheme for filtering water in this way at some place between Indian Orchard and the city might be feasible; but its feasibility can only be definitely determined after surveys have been made to determine the thickness of the porous strata, and the height of the water-table in all parts of the plain. I would advise that this scheme be given careful consideration, and that estimates of the cost of necessary works be made.

With regard to a new supply from some other source than that at present used, — and I would include Jabish Brook in this list, — I would advise that all available sources should be carefully investigated, and comparative estimates of cost should be made, before any source is selected, so that a proper decision may be reached.

Finally, I would suggest that, as the trouble with the Ludlow reservoir is so serious, and as it is not known when this trouble will cease of its own accord or what can be done to prevent it, the city of Springfield should employ the best engineering talent it can get, to investigate and report both the means by which the water from the Ludlow reservoir can be purified before being delivered to the city, and the best source from which a new or additional supply can be obtained, so that action which may involve large expenditures should not be taken unadvisedly.

Respectfully submitted,

F. P. Stearns, *Chief Engineer.*

THE REPORT OF THE CHEMIST.

In the chemical analyses of the water of Ludlow reservoir, the only striking feature is the large amount of nitrogen present in the form of albuminoid ammonia. In the following table, I have arranged by months the determinations of albuminoid ammonia made by Professor Nichols in 1876 and 1877, and those made under my direction during the years 1887-88-89. The samples were generally taken a short distance below the surface, — in no case deeper than six feet: —

Albuminoid Ammonia.

(Parts in 100,000.)

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1876, . . .	– –	– –	– –	– –	– –	– –	.0472 .0336	.0554 .0295	.0748 .0344	.0470 .0296	.0367 .0320	.0372 .0354
1877, . . .	.0315 .0309	.0338 .0301	.0318 .0245	.0229 .0186	.0245 .0222	.0469 .0322	.0591 .0307	.0474 .0293	.0431 .0289	– –	– –	– –
1887, ...	–	–	–	–	–	.0304	.0260	.0910	.0640	.0684	.0300	.0302
1888, . . .	.0500 –	.0314 –	.0228 –	.0245 –	.0238 .0164	.0246 .0222	.0332 –	.0486 .0198	.0428 .0206	.0140 .0228	.0284 .0182	.0242 .0164
1889, . . .	.0232 .0166	.0268 .0196	.0224 .0180	.0258 .0162	.0493 .0199	.0682 .0312	.0753 .0327	.0738 .0239	– –	– –	– –	– –

Note.—The figures underscored indicate the albuminoid ammonia in the water after it has been filtered through paper in the laboratory.

From a large number of experiments made with the brown surface waters of the State, I have satisfied myself that the total nitrogen in solution in these waters is approximately twice the amount of the nitrogen determined in the form of albuminoid ammonia. The following experiments show that, as regards the organisms in the reservoir, the total nitrogen is rather more than twice their nitrogen, as determined in the form of albuminoid ammonia; namely, about two and one-half times. The sample analyzed consisted of a mixture of equal parts of three samples taken near the surface, near the bottom and at mid-depth: —

ANALYSIS OF WATER FROM LUDLOW RESERVOIR.

(Collected Aug. 17, 1889.)

	Residue on Evaporation.			Nitrogen as —		Total Nitrogen Determined.
	Total.	Loss on Ignition.	Fixed.	Free Ammonia.	Albuminoid Ammonia.	
Unfiltered, ...	4.65	2.90	1.75	.0002	.0520	.1250
Filtered, ...	3.35	1.60	1.75	.0002	.0201	.0450
Difference, ...	–	1.30	–	–	.0319	.0800

A rough determination of the nitrogen in dried organisms is obtained by comparing the difference of the loss on ignition, in the unfiltered and filtered water, with the difference of the total nitrogen. From the above figures it is shown to be a little over six per cent.

An accurate determination was made of the nitrogen contents of the organisms in the reservoir, by drying at 100° C. a considerable quantity collected from the surface of the water. This determination gave 7.42 per cent. of nitrogen in the dried mass of algæ.

The difference between the total albuminoid ammonia and that in solution represents the amount of albuminoid ammonia due to the vegetable matter in suspension. If, therefore, we multiply those figures, as obtained from the table, by 2.5, then by the factor $\frac{14}{17}$, to reduce the ammonia to its corresponding amount of nitrogen, and then by 13.48 (a factor based on the amount of nitrogen in the dried algæ; namely, 7.42 per cent), we get an approximation to the actual amount of vegetable matter in a dry condition, suspended in the water. As an illustration, we will take the month of August in the years 1876, 1877, 1888 and 1889: —

	Total Albuminoid Ammonia.	Albuminoid Ammonia in Solution.	Difference.	Total Vegetable Matter in Suspension.
1876, ...	.0554	.0295	.0259	0.7180
1877, ...	.0474	.0292	.0182	0 5050
1888, ...	.0486	.0198	.0288	0.7990
1889, ...	.0738	.0239	.0499	1.3847

It is interesting to note that the number obtained for the total vegetable matter in August, 1889, by this method, agrees very closely with that obtained by "the loss on ignition," given above.

Professor Nichols found, in 1878, under similar conditions, 11.18 per cent. of nitrogen in the dried algæ of the reservoir.* The difference in these two determinations may be due to accidental conditions of collection; or it may, perhaps, indicate that the growth now in the reservoir is less nitrogenous than it was eleven years ago. Professor Nichols mentions *Clathrocystis* as the prominent form in the mass he analyzed; *Anabœna* has been, I believe, more largely developed during the past summer. Both belong to the variety of the blue-green algæ.

As far as I know, there have been very few analyses made of the different kinds of algæ which abound in surface waters. A German authority gives the albuminoid matter in *Spirogyra*, a green alga, as 28 to 32 per cent. If we assume that this albuminoid matter contains 15 per cent. of nitrogen, we have 4.5 per cent. as the nitrogen of *Spirogyra*. Further investigation may show that high nitrogen is characteristic of the blue-green algæ, as compared with the green algæ and the diatoms. An explanation would thus be suggested why it is that the blue-green algæ are the cause of more annoyance in the way of bad tastes and odors than the other algæ. Be this as it may, the fact remains that the water of Ludlow reservoir is the home of a highly nitrogenous growth, which is frequently obnoxiously abundant in the summer and autumn.

Whence comes the nitrogen to support this growth? Since the waters which feed the reservoir — Higher Brook and Broad Brook — contain less nitrogen than the water in the reservoir, we are driven to the conclusion that the bottom of the reservoir — which was, before it was flowed, partly swamp and partly tillage and pasture land — must supply a considerable part of the nitrogen. The fact that the water of the reservoir is in no part t o deep to be turned over by high winds, is favorable to the transfer of the nitrogen from the bottom. The large area of the reservoir is likewise favorable for the growth of the algæ, since the water of the feeders, which are comparatively free from the blue-green algæ, remains a very long time stored in the reservoir in contact with the nitrogenous matter on the bottom.

From May to August (inclusive) of this year samples have been taken weekly from the reservoir, at its deepest portion, at six inches, six feet and eighteen feet below the surface. During May, June and July, the water near the bottom, except during or shortly after high winds, was high in free ammonia, indicating active decomposition in progress, and it had generally a disagreeable, rotting odor. Some of the mud dredged from the bottom at this point had a decidedly offensive odor.

It was thought, when the trouble from this growth was first experienced, that the blue-green algæ would disappear in the course of a few years. An examination of the figures for albuminoid ammonia already given, shows that there is no diminution in amount; in fact, it is generally higher now than it was in 1876 and 1877. The free ammonia in the water has been generally lower during the last two years than it was during 1876 and 1877, as is seen in the following determinations: —

* See ninth annual report of the State Board of Health, p. 157.

FREE AMMONIA.

(Parts per 100,000).

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1876, ...	–	–	–	–	–	–	.0212	.0120	.0390	.0070	.0064	.0121
1877, ...	.0238	.0112	.0035	.0086	.0115	.0082	.0105	.0247	.0081	–	–	–
1887, ...	–	–	–	–	–	.0004	.0114	.0085	.0009	.0000	.0000	.0000
1888, ...	.0000	.0023	.0054	.0059	.0000	.0006	.0042	.0006	.0000	.0010	.0022	.0000
1889, ...	.0002	.0000	.0002	.0000	.0000 .0006 .0002	.0006 .0022 .0128 .0004	.0140 .0000 .0000	.0000 .0008 .0012 .0002	–	–	–	–

During the months of May, June, July and August, 1889, the water was examined three or four times, and all the determinations are given above. The improvement of the water during nearly all the months of the year since 1876–77, as far as evidence derived from free ammonia is concerned, is quite noticeable. At no time during the last two years has the nitrogen in the form of nitrates and nitrites been high, and the chlorine has been the normal of the region. As there is no reason to expect that the trouble from this growth will grow less in the near future, there remains only the resource of a new supply, or some system of filtering the present supply, as discussed in the report of the chief engineer of the Board.

THOMAS M. DROWN, *Chemist.*

THE REPORT OF THE BIOLOGIST.

SIR: — At the request of the Board, I have prepared the following report on the organisms which are contained in the water supplied to the city of Springfield. The report is based upon a microscopical examination of samples of water which were sent from Springfield for chemical analysis, and upon two personal inspections of the Springfield water system.

The water which is supplied to Springfield is collected chiefly from Higher and Broad brooks, and the drainage area which surrounds the Ludlow reservoir. This is a storage reservoir, from which the water is conducted to the city. Here it is delivered to the consumer either directly or after standing a longer or shorter time in distributing reservoirs.

The water which is delivered in the city frequently has a disagreeable odor and taste. Its objectionable qualities have been traced to the Ludlow reservoir. The taste and odor which were characteristic of the water in the reservoir were not observable to any marked degree in the brooks which flowed into the reservoir. The immediate cause of trouble is, therefore, to be sought in the Ludlow reservoir itself.

The microscopical examinations of the water from Higher and Broad brooks indicate no exceptional conditions in these sources of supply. Both brooks contain a few diatoms, desmids and other green algæ. The quantity of growth which was present was rather less than is characteristic of most small streams. In one examination of Broad Brook a few colonies of *Clathrocystis* and *Oscillaria* were recorded. These two genera belong to the blue-green algæ. In the other examinations of Broad Brook no blue-green algæ were observed. Blue-green algæ have never been seen in any of the examinations of Higher Brook. There is no reason for suspecting that the smaller streams which flow into the reservoir contain a greater number of organisms than the two brooks which were examined. The small number of organisms which was recorded from Higher and Broad brooks, accords well with the general absence from the brook of disagreeable odors, etc.

On comparing the microscopical examinations of the water from the brooks and from the Ludlow reservoir, a marked difference can be seen.

The water in the brooks contains few organisms; that in the reservoir contains an immense number. This fact offers an explanation for the odor and taste which accompany the water from the reservoir, but which are absent from the water in the brook.

The organisms which occur in the Ludlow reservoir are those which are characteristic of most storage reservoirs. The more abundant genera are as follows: among the diatoms, *Asterionella* and *Melosira;* of the desmids, *Staurastrum;* of the other green algæ, *Chlorococcus* and *Scenedesmus.* The blue-green algæ were represented by *Anabæna*, *Clathrocystis* and *Cœlosphærium.* Although the entomostraca, rotifers and protozoa were somewhat numerous, the only animal which was present in exceptional numbers was *Dinobryon.*

The distribution of organisms during the year was as follows: *Asterionella* was present during the whole year; it was somewhat more abundant in winter than in summer. *Melosira*, which occurred throughout the year, reached its greatest development about March and April. *Staurastrum* was chiefly characteristic of summer. *Scenedesmus* and *Chlorococcus* were observable during the whole year. The blue-green algæ, although they were found during the greater part of the year, were distinctly characteristic of summer. The period in which *Dinobryon* was in greatest numbers was from January to April.

The water from the Ludlow reservoir has been especially unsatisfactory at two periods of the year; namely, during the summer months and in January. The period of the winter trouble corresponded to the period when *Dinobryon* was most abundant, and there is little doubt that this organism is the cause of the winter trouble. In January, 1888, a swarm of individuals of this genus, apparently originating in the Ludlow reservoir, were carried in the water to Springfield. At the time of their presence much complaint of the water was made. Although *Dinobryon* was abundant during January, February and March, 1889, it was not so numerous as in the former year, and the winter trouble of this year was not severe enough to call forth especial complaint.

It is fair to presume that the cause of the summer trouble is the growth of the algæ. What particular alga or group of algæ have given rise to this trouble, is not so easily determined. The diatoms are slightly more abundant in winter than in summer. *Staurastrum* is more frequently met with in summer. Judging from size and numbers, the increase of *Staurastrum* in the summer would be balanced by the increase of diatoms in the winter. As the other green algæ are not especially abundant at particular times of the year, it can be stated that the green algæ on the whole are about as abundant in summer as in winter. The blue-green algæ, on the other hand, are characteristic of summer. There is a strong probability that they are the important factor in producing the summer trouble. Of the blue-green algæ, *Anabæna*, *Clathrocystis*, and *Cœlosphærium* are the three most objectionable genera. These three genera are found in the Ludlow reservoir. The turbidity of the water at Ludlow reaches its height in summer, and is chiefly due to these plants. It is probable also that much of the

disagreeable odor and taste observable at this period is produced by these blue-green algæ. It must be borne in mind, however, that the green algæ, etc., are present in sufficient numbers to warrant the prediction of trouble during heated seasons, and it is highly probable that they aid in producing the summer trouble. Nevertheless, I am inclined to believe that the severity of this trouble is due to the blue-green algæ.

The foregoing statements can be summarized as follows: There is but little doubt that the winter trouble in the Ludlow reservoir is produced by *Dinobryon*. The probable cause of the summer trouble is an excessive growth of blue-green algæ, augmented by the presence of a considerable amount of green algae.

The past record of the Ludlow reservoir gives very little hope that natural causes will bring about an immediate abatement of the excessive growth of organisms. I am at a loss to suggest any means of remedy which is consistent with the retention of the Ludlow reservoir. All the troublesome organisms can be separated from the Ludlow water by filtration, and after aeration there is little question but that the water would be greatly improved. Whether a system of filtration and aeration as extensive as Springfield would require is practicable, or not, lies beyond the province of this report.

Respectfully submitted,

G. H. Parker.

Quincy. The city of Quincy is supplied with water by the Quincy Water Company. The transfer of this supply to the city having been contemplated, the committee on water supply applied to the State Board (Oct. 22, 1889) for its advice in relation to the quality of the supply which is furnished by the company. To this application the Board replied as follows: —

Boston, Nov. 15, 1889.

The sources from which the Quincy Water Company can draw a supply are three in number: —

1. The water which filters naturally into the wells in Quincy from the ground in their vicinity.

2. Water from the storage reservoir on Town Brook in Braintree.

3. Water from Town Brook in Quincy, at a point opposite the wells. This water, under existing conditions, may be diverted directly into the wells, or imperfectly filtered through an artificial gravel filter on its way to them.

Analyses have been made during the past two years of water from the wells and storage reservoir of the Quincy Water Company, and from the brook entering at the head of the reservoir. Copies of these analyses are appended. They show that water

taken from the wells, when no brook water is being divérted into them, is nearly colorless, and, judging from the amount of ammonia present, contains but a moderate amount of organic matter. This shows that any sewage filtering into the wells from the neighboring houses is purified to a large extent by its passage through the ground. The large and increasing number of houses in the neighborhood of the wells is likely to make this source decidedly objectionable in the near future, unless a system of sewerage is provided, and each house is connected with it.

Samples of water have been received for analysis from the brook entering the storage reservoir, and from the reservoir near the gate house, from November, 1888, until the present time. The water entering the reservoir during a large portion of the year is very dark colored, and contains a large amount of organic matter in solution, also some in suspension in the form of minute organisms.

The amount of organic matter found in the water of the reservoir is generally greater than that in the water of the brook; and from July 15, 1889, until the present time, it has been much greater, indicating either that the character of the water has favored the growth of minute animal and vegetable organisms, or that organic matter has been dissolved from the material forming the bottom and sides of the reservoir.

The water entering the reservoir during a part of the year contains too much organic matter and is too highly colored to furnish a satisfactory water supply under existing conditions. It is probable, however, that the character of this water might be improved by the drainage of swamps and meadows in the watershed, or that the water of the brook might be diverted from the reservoir during the season of the year when the character of the water is unsatisfactory.

The examinations of the water of the reservoir have not covered a long enough period after its first filling to determine whether it will be a satisfactory permanent source of supply for Quincy. In advising at the present time, it may be said that the increase in the amount of organic matter and in the number of organisms in the water, after it has stood in the reservoir, together with the character of the water entering the reservoir, indicates that it may give trouble from bad tastes and odors, such as have occurred under somewhat similar circumstances, in several places in the State.

The reservoir has a drainage area of 991 acres, and a storage capacity of 180,000,000 gallons. On the basis of records kept by the city of Boston of the flow of Sudbury River, the reservoir

without loss by filtration will furnish during the driest year nearly 1,000,000 gallons of water per day. From this quantity some deduction should be made for the quantity which filters past the dam and through the sandy material at the side of the reservoir. There are but few inhabitants on the watershed to pollute the water with sewage. The results of examinations to the present time do not enable this Board to advise that the water from the reservoir will, at all seasons, be satisfactory. Before adopting it as the future source of supply, the Board would advise you to make investigations, to determine if the quality of the water entering the reservoir may not be improved by intermittent filtration through sand and gravel beds, which we are informed are to be found near the upper end of the reservoir; and also to determine if the organic matter, which has increased rapidly in the water of the reservoir since July, can in a similar manner be filtered out through the sand and gravel in the vicinity.

The watershed of Town Brook between the wells and the dam contains a large population in Braintree and many houses in Quincy, together with extensive meadows and swamps; and the water of this portion of the brook is of such a character that it should not be diverted into the wells, or otherwise used as a source of supply.

Brant Rock (in Marshfield). Mr. B. S. Bryant, a resident of Marshfield, having applied to the Board (Nov. 6, 1889) for its advice with reference to a water supply for a portion of that town known as Brant Rock, the Board replied as follows: —

Boston, Dec. 3, 1889.

The Board has caused an examination of the locality and an analysis of water from the present source of supply to be made. The analysis indicates that at the time the sample was collected the well water was not polluted by organic matter, but that it contained much more than the usual amount of salt.

Both the analysis and an examination of the surroundings indicate that a greater draught upon this well would cause the water in it to become polluted, and be too salt for domestic use. The Board therefore advises you to seek a supply from a well to be located in some place further from the sea, where there is considerable land draining towards the proposed well; and suggests that a proper location for a well may be near the base of the hill comprised in the Liversedge estate (so called), at a point away from any present or contemplated buildings, provided suitable ground can be found in which to sink the well.

Sewerage and Sewage Disposal.

Under the provisions of the same statute (chapter 375 of the Acts of 1888) and certain special acts, the following cases were submitted to the Board for its advice during the year: —

Gloucester. The city of Gloucester having applied to the Board for its advice (Nov. 15, 1888) in relation to a proposed system of sewerage and sewage disposal for that city, the Board replied as follows: —

Boston, Jan. 9, 1889.

It would not be advisable to admit sewage to the drain now receiving brook and storm water, and discharging upon the beach near Western Avenue. A satisfactory outlet for the sewage of a large part of the city will not be provided by building the proposed sewer in Western Avenue to carry the contents of the existing drain to the waterway known as the "Cut."

The existing plans being unsatisfactory, the city should have the sewerage question re-examined by some engineer competent to deal with this somewhat difficult problem.

Northampton. By the provisions of chapter 354 of the Acts of 1888, the city of Northampton was authorized to construct a system of sewers. Previous to the hearing, which was provided for in section 2 of the aforesaid act, a preliminary conference was held, for the purpose of considering certain questions relative to the sewerage and sewage disposal of the city; the result of which conference, together with the suggestions of the Board, and also the question of constructing a storm-water drain in State Street, with the Board's opinion thereon, are given on pages 21 and 22 of the last annual report of the Board.

Public notice of a hearing having been published in the newspapers of Northampton and Holyoke, Jan. 16, 1889, pursuant to the provisions of chapter 354 of the Acts of 1888, the hearing was held at Northampton, Feb. 5, 1889, at which the sewer commissioners of Northampton, the State Board of Health, and members of the boards of health of Northampton and Holyoke, were present. The plans for

the system of sewerage and sewage disposal having been presented and carefully considered by the Board, the following reply was given: —

BOSTON, March 22, 1889.

The Board has considered the system of sewage disposal presented by the Board of Sewer Commissioners of the city of Northampton, under section 2 of chapter 354 of the Acts of 1888, which is as follows: "Said board of commissioners alone shall have authority, and it shall be the duty of said board to adopt and establish a system of sewerage and sewage disposal for said city; but no such system of sewage disposal shall be constructed, until said system and location have been approved by the state board of health, after fourteen days' notice by said board, of the presentation to it of such system for its approval, by a publication of such notice, with a time and place for a hearing thereon, in such papers and at such times as said board may deem proper; and said board after hearing may reject such system, may approve it or may modify and amend the same and approve it as so modified and amended."

The sewer commissioners presented a plan for a system of sewers and for sewage disposal for the parts of the city that are presently to need sewers, including Northampton Centre and Florence, and the villages between; and, after the legal notification, a hearing was given at the city hall in Northampton, on Feb. 5, 1889.

The plan for the ordinary disposal of sewage, as presented by the sewer commissioners, is to discharge the crude sewage into Mill River from two main outlet sewers, at points shown on said plan to be situated 1,450 feet below the junction of Pleasant and Williams streets.

The quantity of water flowing in Mill River at the proposed outlet is very variable, and during very dry weather, in the night, and on Sundays, the water is held back at the several mill-dams, so that nearly all that is then flowing is leakage through the dams and wheels. This amount is said to be greater than the amount of sewage that will presently be discharged; and at or near the proposed outlets, the water of Mill River is said to be dead water, held back by the Connecticut River nearly a mile away. The proposed outlet is about a quarter of a mile from the nearest house; and, unless high waters of Connecticut River are excluded by expensive dikes, houses are not likely to be built within one thousand feet from the outlet.

The disposal of the sewage of Northampton, by turning it into Mill River at the point proposed, may be prejudicial to the health

of the community, or not, depending upon the relative quantity of sewage and water flowing in the river. The fractional part of the sewage of the city that will be conveyed to the outlet during the early years of the construction of the system of sewers may, in the judgment of this Board, by proper regulations be discharged into Mill River without injury; but the Board does not consider this a suitable outlet for the sewage of the completed works by the plan presented for the future city of Northampton. The Board therefore modifies and amends the system of sewage disposal proposed by the commissioners, by extending the main sewers from near the proposed outlets into Mill River, to an outlet into the Connecticut River, with the provision that such extension be made within ten years from the date hereof, unless the time be further extended by the State Board of Health; and that in the mean time the sewage may be disposed of by discharging it into Mill River at points where, in the lowest stages of this river at night, the bed of the river shall be at all times covered with at least one foot in depth of water for a width of fifteen feet, and that below the outlets of the sewers and all the way between them and the Connecticut River there shall be maintained at all times a depth of water at least one foot deep, and having a width of fifteen feet.

By the plan presented by the commissioners, the sewage from Florence and the western portion of Northampton Centre is to be conveyed in a thirty-six-inch sewer across the low territory on the south-westerly side of Mill River, which is so low that, but for the dikes, water from Connecticut River would stand in times of great freshet several feet upon the streets of this territory.

It is evident that the sewer connected with houses in this territory cannot be used for conveying sewage to the proposed outlet in Mill River at time of such freshet. It will be necessary for this sewer within this low territory to be cut off by a substantial gate from the sewer outside of the dike below this territory, and by another gate cut off from the incoming sewage from above; and the down-coming sewage must be for the time otherwise disposed of. The commissioners proposed to turn the down-coming sewage into Mill River, near the bridge a short distance below the lower dam. With a large quantity of water flowing down Mill River, such disposal may be allowed; but it is evident that such disposal would be objectionable with a comparatively small quantity of water flowing down Mill River; and the Board cannot approve of the disposal of sewage at this point, even as a temporary measure, at times when there is not a continuous flow of water through this section of the river, day and night.

The plan of sewers for the city presented by the commissioners

contemplates receiving sewage only from one large area, but from another area, including nearly all of Northampton Centre, sewage and storm water are to be received. The latter are to be conveyed until passing near drains on the lines of old brooks, where a portion of the mixed sewage and storm water, during and immediately after a heavy fall of rain, overflows into these drains, which pass through thickly settled neighborhoods and discharge into Mill River.

In some places these drains consist of brick conduits of uniform section; in other places, of culverts having plank floors and stone walls also covered; and in still other places they remain as open drains. It is intended that, except during and immediately after storms and thaws, all sewage shall be excluded from these drains, and it is to be expected that in a dry time little or no water will flow in them; but, unless made with permanent smooth bottoms, deposits will form, causing pools of objectionable matter. And the Board of Health would modify and amend the plan of the commissioners, as presented, by providing that the overflow from sewers shall be turned into covered drains only, and that these shall be so constructed that they will tend to keep free from deposit, and shall be so covered and formed throughout their whole length from the highest point at which they receive overflow from sewers to Mill River.

As herein modified and amended, the State Board of Health approves the system of sewage disposal proposed by the Board of Sewer Commissioners of the city of Northampton.

As chapter 354 of the Acts of 1888 refers the system of sewage disposal definitely to the approval of the State Board of Health, but does not so refer the system of sewerage, the Board does not herein express any judgment upon the latter.

WESTFIELD. In the last annual report of this Board (page 20), it was stated that the town of Westfield, after having presented a plan for the sewerage and sewage disposal of the town, was recommended by the Board to reconsider the subject, and to present amended plans. The town adopted the recommendation of the Board, and renewed its application for advice (March 18, 1889), the application being accompanied with an amended plan, to which the Board made the following reply: —

APRIL 23, 1889.

The Board has examined the plans presented by the committee on sewerage of the town of Westfield, with the accompanying reports, and has examined the localities to be benefited.

The proposed plan for conveying the sewage of the village of Westfield south of Westfield River by a system of sewers from which surface water is to be excluded, to an outlet into Westfield River near the mouth of Town Brook, is in the judgment of the Board well adapted for the present and future wants of the town, and is approved.

The Board is informed that it is the desire of the committee that the plans presented for storm drains of the main village and for sewers for the north side of the river be regarded as withdrawn for further consideration, to be presented at a future time.

WINTHROP. The authorities of Winthrop requested the advice of the Board in 1886, relative to a proposed system of sewerage and sewage disposal for that town. The plan included an outlet upon Winthrop bar. The reply of the Board to this application is given upon page xlix of the eighteenth annual report of the Board (1886). Early in 1888 a modification of this plan, involving discharge of the sewage into Snake Island channel, inside of Point Shirley, was presented to the Board. The Board did not approve of this plan, as stated in the twentieth report of the Board, page 15.

The Legislature of 1888, by the provisions of chapter 260 of that year, authorized the town to lay out, construct and maintain a system of sewerage and sewage disposal. If the town failed to construct the sewerage system within one year from the passage of the act, the State Board of Health were required, by section 10 of the same act, on the petition of ten resident owners of real estate, to order the town forthwith to construct the said sewerage system, if in the opinion of the Board such action was necessary for the preservation of the health of the inhabitants. At the close of the year such a petition was presented to the Board, and a hearing was granted to the petitioners. Previous to the hearing, however, the town authorities of Winthrop had presented a plan to the Board for such action as was required by section 1 of the same act. They had also received the reply of the Board, involving a general approval of the plan, and had entered upon the construction of the sewerage system. Consequently at the date of the hearing, the petitioners did not appear, and no further action by the

Board was necessary. The final reply of the Board was as follows: —

BOSTON, May 7, 1889.

The Board received a plan and description of a proposed system of sewerage for a part of Winthrop early in October, 1888. This plan contained important features, similar to those contained in a plan submitted to this Board in 1886, which the Board then reported as objectionable. Upon being notified, the engineer of the town withdrew the plan, and about Jan. 25, 1889, submitted a revised plan and description, with a tracing showing the courses of floats near the proposed outlet.

On January 28 the engineer was notified that none of the floats represented were observed during the time of tide when sewage would be discharged, and was requested to furnish information as to the currents at the time of tide when sewage would be discharged. On April 13 he submitted a supplementary plan, showing the courses of additional floats.

From the data furnished and the examinations made by the Board, the system of sewerage and sewage disposal for the portions of the town of Winthrop known as Ocean Spray, Great Head and Cottage Hill, as submitted by the Board of Selectmen through H. T. Whitman, their engineer, meets with the approval of the State Board of Health, except in regard to the location of the outlet. The outlet should, in the judgment of this Board, be upon the south side of the bar, and not upon the north side, as proposed. For an outlet to be used many years hence, the distance from the shore should be, in the opinion of the Board, as much as one thousand feet; but, for the amount of sewage that is likely to be discharged within the next five years, the outlet may be permitted at a distance of five hundred feet from the shore.

In concluding, the Board would repeat its opinion heretofore expressed; that, "for complete sewerage of Winthrop in the future, the general [North Metropolitan] system presents advantages in grades, in cost of pumping and in removing the sewage to a distance which will be unobjectionable, that would make the outlet [of this system] preferable to any which the town can provide for itself; but, for the immediate relief which Winthrop requires," this Board approves of a temporary outlet on the south side of the bar, five hundred feet from the shore.

REVERE. The sewerage committee of Revere submitted to the Board a plan for the sewerage and sewage disposal of that town, accompanied with a statement of the intention of

the committee to apply to the Legislature for a special act, authorizing them to construct a system of sewerage. This application was accompanied with the draft of a proposed act, which required the subsequent approval of the plan by the State Board of Health. The application was received near the close of the legislative session (May 6, 1889) ; and the subsequent adverse action of the town soon after that date rendered the proposed action of the State Board unnecessary.

Pittsfield. The earlier action of the State Board with reference to the sewerage and sewage disposal of Pittsfield is given upon page 16 of the twentieth annual report of the Board (1888). After a public hearing had been held at Pittsfield in April, 1888, and the advice of the Board had been given, the town authorities adopted the advice of the Board, and finally presented an application and plan, under the provisions of the general act of 1888. To this the Board replied as follows: —

Boston, Dec. 13, 1889.

The Board has carefully considered the application of your committee, dated May 28, 1889, relative to the introduction of a system of sewerage in the town of Pittsfield, and now presents its reply.

In explanation of the long time which has elapsed since the receipt of your application, the Board would state that it gave a hearing to your committee on June 4, 1889, and during the month of June caused the plans and estimates submitted by you to be carefully examined, and also caused investigations to be made by its engineer at Pittsfield. At the meeting of the Board, July 2, 1889, the plans not being satisfactory in some respects, the engineer of the Board was instructed to confer with your engineer, and this conference was held at the earliest opportunity. Immediately after this conference, which was held on July 18, 1889, a communication was received from your engineer, asking for another conference, after he should obtain certain additional information, and before the report of the Board was sent out. This information was presented to the Board Nov. 21, 1889.

The main features of the scheme submitted are as follows: —

1. A system of sewers, from which storm water is to be excluded.

2. High-level main sewers on the east and west sides of the

higher portions of the town, uniting in the southerly part of the town, and running thence to an outlet on land south of Williams Street, at an elevation of about thirty-seven feet above the river.

3. Low-level main sewers on the east and west sides of the town, near the east and west branches of the Housatonic River.

4. Storage tanks and pumping stations at Van Sickler's and Pomeroy's mills, to receive the sewage from the low-level main sewers, and pump it at night into the higher ones.

5. The disposal of the sewage by filtration through two tracts of land: one, bounded by South, Williams and Willis streets, and the east and west branches of the Housatonic River, is known as Field No. 1; the other, situated easterly from the east branch of the river, and between Willis Street and the river, is known as Field No. 2.

Taking the plan submitted as a whole, the Board finds that it is permissible, provided sufficient power can be obtained for pumping the sewage at the mills above mentioned; but is of the opinion that there is another plan which will be cheaper, and better from a sanitary point of view. The plan which the Board suggests, while retaining as a feature the exclusion of storm water from the new system of sewers, would abandon the high-level main sewers, the storage tanks, and the pumping stations at the mills. The sewage would all be allowed to flow into the low-level main sewers, and these would be extended to a point near the confluence of the east and west branches of the river, where a pumping station would be established, to lift the sewage about ten feet higher than the outlet shown on the plan submitted. By raising the sewage to this height, all of the land in Field No. 2, which is the larger of the two fields selected, and other land on the south side of the river, might be made available for present or future use for filtering the sewage, thus making it unnecessary to use Field No. 1, which is so near the town that other area farther removed would be preferable. The additional area made available in Field No. 2 by the plan herein suggested would be as large as the whole available area in Field No. 1 by the plan submitted.

Considering more in detail the main features of the plan submitted, in the order in which they were previously referred to, the Board finds: —

First. That a system of sewers from which storm water is excluded is the best for removing the sewage of Pittsfield; and it is desirable that not only the storm water from streets and roofs should be kept out of the sewers, but also ground water, as far as possible, so that there may be the smallest possible volume of sewage to be purified before it enters the river.

Second. That the high-level main sewers are advantageous, in that they would discharge some of the sewage of the town at a sufficient elevation above the river to permit this portion of the sewage to be purified without pumping it. As compared, however, with the scheme herein suggested, there are the following disadvantages: The high-level main sewers add materially to the first cost of the whole scheme, both on account of the cost of constructing them, and on account of the land damages which would result from their location so much of the way in private property. Their outlet is lower than large portions of the sewage fields selected, and these portions could not be graded to the proper elevation without the removal of a very large amount of earth. From the information now in possession of the Board, it is of opinion that the abandoning of the high-level main sewers and the extension of the low-level main sewers to a single pumping station, as above suggested, would not only result in a material reduction in the first cost of the works, but would also reduce the yearly expenses, when the payments on account of interest and sinking fund are included.

Third. That the west side low-level main sewer at its lower end is shown, by the plan originally submitted, to be thirty-two inches in diameter. A smaller sewer, say twenty-four inches in diameter, laid upon a grade obtainable by equalizing the grades, would carry the sewage and the foulest of the manufacturing wastes produced in this valley for a long time to come, provided the amount of water entering the sewers is restricted to the extent that is desirable where sewage has to be purified. Going up this sewer, its size is reduced at several points. Below the corner of River and Alder streets it is twenty inches or more in diameter, while above this point to Seymour Street it is eighteen inches in diameter. On Seymour Street from Division Street to the limits of the fire district, its diameter is less than eighteen inches. If the upper portion of this sewer was made nowhere less than eighteen inches, or possibly twenty inches, in diameter, it would be large enough to take the sewage and foulest manufacturing wastes from the villages and mills in the north-westerly section of the town when sewers are built in this section. The Board advises that the upper portions of the main sewer be made sufficiently large to provide for this portion of the town. The east side low-level main sewer is shown upon the plan to be twenty-eight inches in diameter. The diameter of this sewer might be reduced to twenty-four inches, even if the high-level main sewer is omitted.

Fourth. The location near dwellings and factories of the two pumping stations indicated on the plan submitted, and of the large

storage tanks required to hold the sewage during the day, is undesirable on sanitary grounds; while a pumping station located near the confluence of the two branches of the river would not be objectionable. It was stated, with reference to the plans submitted, that the pumps were to be operated at night by water power. The amount of water power available at night at Pomeroy's dam in a dry season, when the gates are closed at the outlets of Lakes Onota and Pontoosuc, would, from information obtained, be insufficient for pumping the sewage. The Board is not fully informed with regard to the amount of water power at present available during the night at Van Sickler's dam, and advises the town to investigate carefully the amount of water power available at both dams, before adopting any scheme which depends upon water power for pumping the sewage.

Fifth. The best method of disposing of the sewage of Pittsfield is to purify it by filtration through land before allowing it to enter the river. The upland portions of the sewage fields, shown on the plan submitted by the fire district, appear to be composed of porous sand and gravel, which are well adapted for filtering sewage. Information furnished by your engineer shows that Field No. 1 contains thirty acres of upland, and Field No. 2 seventy-five acres of upland, making the total area of upland one hundred and five acres. No estimate has been furnished of the amount of land too high to receive sewage from the outlet shown on this plan, but it is probable that a sufficient area is low enough for present use. In the future, when additional area becomes necessary, a third pumping station is likely to be needed, in connection with the scheme submitted, to make this area available.

The Board advises that the suggestions herein presented be carefully considered, and that complete comparative estimates of cost by the two schemes be prepared, before deciding upon the plan to be adopted.

THE STATE NORMAL SCHOOL AT FRAMINGHAM. The trustees of this school requested the advice of the Board (May 28, 1889) relative to a proposed plan for the sewage disposal of the school, upon a tract of land near the Sudbury River, to which the Board replied as follows: —

BOSTON, July 2, 1889.

The Board has considered the application, dated May 28, of the Framingham Normal School for advice in regard to taking sewage from the school buildings in a southerly direction through a pipe, to land which is from one hundred and fifty to four hundred feet

from the wells which supply water to the school. It is proposed to run the sewage into a settling tank, and then to distribute the liquid beneath the surface in French drains.

For prudential reasons no test-pits have been dug either by the trustees or by this Board, to determine the quality of the material of the tract. From the appearance of the surface and of water coming to the surface drains above and westerly from the tract, it is probable that the drains would deliver the sewage very near, if not directly into, material saturated with ground water; in which case it would be likely to percolate continuously, with imperfect purification, to the wells.

The Board would therefore advise seeking a tract of more porous sand and gravel, better suited for filtration, and farther removed from the wells. There appear to be such tracts in the vicinity, but their location is not specified, for the prudential reasons above mentioned.

Subsequently, the trustees had test-pits dug, and suggested that if the wells near the river should be injured by the sewage disposal, the water of certain wells on the hill near the school might be used, instead of the supply then in use from the wells near the river. The Board replied as follows: —

Boston, Aug. 9, 1889.

Examination by test-pits in the tract of land south of Maple Street, confirms the opinion of the Board expressed in letter dated July 2, 1889, that the method of disposal of sewage presented would be likely to injure the water supply of the school.

In response to the suggestion that this water supply might be discontinued for drinking, and recourse be had to the wells on the hill adjacent to the Normal Hall and May Hall, the State Board of Health has had an analysis of each of these waters made. The analysis of the waters from the wells on the hill indicates that the water entering them has been somewhat polluted and again partially purified by filtration. The result is not such as to condemn the latter waters for a drinking supply, but to render them subject to suspicion, making it desirable, that, if used, frequent analyses should be made, to determine their varying quality.

Everett. By the provisions of the Metropolitan Sewerage Act of 1889, the town of Everett was included in the territory intended to be relieved by the general sewerage system referred to in this act. Under the provisions of the

General Act of 1888 (chapter 375), the sewerage committee of Everett submitted to the Board (June 12, 1889) a plan for the sewerage of the town, involving temporary outlets into the Mystic and its tributaries. The Board replied to this application as follows: —

Boston, July 23, 1889.

The State Board of Health has considered your application, dated June 12, 1889, for advice with reference to the sewerage and drainage of the town of Everett.

The general features of the proposed system of small pipe sewers to take sewage only, shown upon the plan submitted, and intended to discharge into the Metropolitan intercepting sewer when built, meet with the approval of the Board, as also does the construction of a portion of the system, limited to districts where sewerage is urgently needed, with a temporary outlet in Broadway near the railroad, into a drain to be constructed, extending from this point to the Mystic near the point marked E on the plan submitted.

The location of the terminal and overflow outlets of the drains for the removal of surface water, substantially as proposed by the plan submitted, also meets with the approval of the Board, except that it advises that provision be made for closing the overflow at G, if it should be found to discharge too much polluted water into the territory from which Malden takes its water supply.

A drain of the size proposed from point L on Broadway to the outlet marked E will be large enough, provided the overflow at L has sufficient capacity; but elsewhere the sizes of the drains where given appear too small, taking into consideration the number of overflows provided, and the territory at present or in the future to be taken care of. The Board would therefore advise the town to have this matter reconsidered, after more definite information has been obtained as to available grades.

It is very important that Everett and the other towns in the Mystic valley, in introducing systems of sewerage, should restrict as much as possible the volume flowing in the sewers, both to diminish the annual charge for a connection with the Metropolitan sewerage system, which must depend upon the amount to be pumped, and to defer as long as possible the date when the ultimate capacity of the system will be reached.

Rain water both from the surface of the ground and from roofs should be wholly excluded from the sewers, and soil water should be kept out by making the sewers as nearly water-tight as possible; and by other methods, such as the construction of the drains

to take surface water at a lower level than the sewers; and, in side streets, where such drains are not to be built, the construction of a small pipe drain in the bottom of the sewer trench, connecting at its lower end with one of the larger drains.

THE TRUSTEES OF THE MASSACHUSETTS SCHOOL FOR THE FEEBLE-MINDED. The trustees submitted an application for advice and a plan of a proposed method of sewage disposal for one of the new buildings of the school at Waltham (June 25, 1889). To this the Board replied as follows: —

BOSTON, July 23, 1889.

The Board has considered your application for advice in regard to a proposed system for the disposal of the sewage of the custodial ward of the school.

The Board would advise, first, that before deciding upon the disposal of sewage from a single department, a plan should be matured for the disposal of sewage from all parts of the institution. This is especially desirable, if, as has been suggested, a partial water supply is to be obtained from the premises. In this case the source of the water supply should first be determined, and the field for the disposal of sewage should then be selected, so as not to pollute the water supply. The material selected for disposal of sewage of the custodial ward does not appear to be so well adapted to this purpose as the loose, gravelly land near the main entrance to the grounds.

The Board would advise seeking an area of favorable material, where the sewage of the whole institution can be disposed of, upon the basis of one hundred gallons per day per individual. If such an area be found, see how the cost of disposing of the sewage of the custodial ward upon it will compare with the scheme now proposed.

If, however, the present scheme appears preferable, the Board would advise a review and modification of the details of the plan, making, among other changes, a larger settling tank with a ventilating pipe to the boiler house chimney, and a drain pipe at the bottom to convey the accumulated deposit to some point down the hill, where it can be conveniently cared for without creating a nuisance.

If the storage tank is to be discharged but once a day, it should be large enough to hold one hundred gallons per head, should be more substantially built, and should be provided with an overflow. The sewage-disposal area should be arranged in two or more sections, which can be used independently; and provision should

be made for discharging the sewage upon the surface of the ground away from the disposal area, if for any reason it should be found desirable.

It would be well to fill small stone and coarse gravel by the sides and above the pipes, and cover this with fine screened gravel and as much as ten inches of soil.

The underdrains appear too small, and it may be desirable to convey the ground water of the higher land around the filtering area.

An amended plan was then presented by the trustees (Sept. 20, 1889), and the Board made the following reply: —

Boston, Oct. 3, 1889.

The Board has considered your application, dated Sept. 20, 1889, for advice upon an amended plan for the disposal of the sewage of the custodial ward of the school.

The Board finds, by comparing the plan now presented with the former one, that the storage tank has been enlarged to hold a day's sewage, at a larger rate per head than was originally contemplated. The area which it is now proposed to prepare for sewage disposal is very much larger than the area shown on the former plan.

In a system like that proposed, in which the contents of a tank are to be suddenly discharged into a system of sub-soil distributing pipes, it is necessary that the pipes and the interstices between the stones surrounding the pipes should have nearly as much capacity as the tank. When a disposal area is to be divided into two independent sections, each must have sufficient capacity to receive the contents of the tank. The length of distributing pipe which it is necessary to provide, therefore, depends both upon the size of the tank and the capacity of the drains per foot. The area should be sufficient for disposing of the sewage, but with a large tank and small drains an additional area may be needed, to accommodate the great length of drain required. In the present instance, one acre * of land will probably be sufficient in the beginning. The capacity of the drains may be largely increased by digging the trenches deeper and wider, and filling beneath and beside the pipe with stones. There is no serious objection to making the tank so small that it will have to be emptied many

* This estimate of area is made upon the basis that surface and ground water from the land above the disposal area will be intercepted, and that the disposal area will be provided with efficient underdrains.

times a day; since, if this cannot conveniently be done by hand, it is feasible to provide automatic machinery for doing it efficiently.

The settling tank has not been provided with a ventilating pipe to the boiler-house chimney. The Board thinks it very desirable that this feature should not be omitted.

The underdrains, which should be made larger, should not discharge directly upon the neighboring property.

Franklin. The selectmen of Franklin applied to the Board for its advice (July 19, 1889) relative to a proposed plan of sewage disposal for a small portion of that town, to which the Board replied as follows: —

Boston, Aug. 7, 1889.

The State Board of Health has considered your application for advice in regard to a plan made by J. W. Ellis, C. E., for carrying the sewage from buildings in the central part of the town of Franklin to land easterly from the town and southerly from the New York & New England Railroad, and there purifying it by filtration.

The area selected appears to be well adapted to purify the small quantity of sewage that is proposed to be brought to it. The plan submitted does not show the details of the settling tank, or the method of preparing the filtration area for the disposal of the sewage. As the success of the proposed plan will depend very largely on the proper design, construction and maintenance of these features, the Board will be ready to advise upon these points when the plans are submitted.

The plans referred to in this reply were soon submitted to the Board; and, after consideration by the Board, the following reply was sent to the selectmen of Franklin: —

Boston, Oct. 2, 1889.

The plan submitted shows three settling tanks, each twenty feet long, ten feet wide and ten feet deep, having an earth bottom and loose stone masonry sides. Each tank is provided with an opening in the side seven feet above the bottom, and when the sewage rises to this opening it will overflow into a ditch three feet deep, loosely filled with stones. Provision is made for closing these openings with stop planks; and, if the opening in the first tank is closed, the sewage will overflow into the second one, and in the same manner into the third. The ditches filled with stones have a steep pitch towards the swamp, and, unless the sewage is

absorbed before reaching the lower ends of the ditches, it will probably accumulate there and ooze out into the swamp.

The Board would suggest modifications of these plans as follows: Make a water-tight settling tank, preferably of brick; say seven feet in diameter and four feet deep below the inlet pipe. The outlet pipe which should be a very little lower than the inlet, should have its end in the tank turned down by a quarter bend or T branch, so as to prevent grease and other floating substances from flowing out. From the side of the tank, at the bottom, a pipe provided with a gate should be laid, coming to the surface of the ground farther down the hill for discharging the deposits from time to time. These deposits could be turned into holes dug in the gravel, and covered with loam after the water soaks away. The bottom of the tank should slope towards the pipe.

The sewage after leaving the settling tank should be turned into ditches, which may be built as shown on the plan submitted by the town, or may be merely shallow open ditches, say four inches deep and one foot wide on the bottom; but, in either case, there should be several independent ditches, and they should run along the side hill with an inclination not exceeding one in fifty where such an inclination is feasible. Open ditches, if kept in order, would give satisfactory results in summer, but in winter it may be necessary to cover them with boards to keep out the snow. For properly filtering the sewage, it is essential that it should be turned into one ditch or set of ditches at one time, and then turned into others, allowing the first to remain idle several hours after the surface becomes uncovered. These changes should be made as often as once a day; and gates or switches should be provided by which the sewage can be turned from one ditch to another with very little labor, so that there will be no excuse for neglecting the work.

If practicable, let the lower fifty feet in length of each ditch have width and slope of bottom continue to the end; but build up the bank so that the top of the bank through this length will be level, thus forming a small reservoir at the end of each ditch.

Provide a large, level ditch near the bottom of the slope, with a bank on the side toward the swamp, made from the material thrown out of the ditch, to prevent sewage accidentally overflowing from the upper ditches from running into the swamp without being filtered. This ditch should not ordinarily be used.

The bottom of the ditches will probably need to be cleaned once in two months, by having a half-inch in depth of material removed.

The accompanying sketch is intended to suggest the general

arrangement of a plan for filtering sewage on a gravelly side hill. It would require modifications, to suit the topography of the ground where applied to a particular case.

Medway. The selectmen of Medway applied to the Board (July 29, 1889) for its advice relative to a proposed plan of sewage disposal into a swamp in that town, to which the Board replied as follows: —

Boston, Sept. 11, 1889.

The State Board of Health has considered your application, dated July 29, 1889, for advice with reference to a proposed plan of disposing of sewage by discharging it into a swamp back of Oakland Cemetery, and has caused examinations to be made of the premises. It advises that it is not desirable to dispose of the sewage or manufacturing wastes in this way, but that it should be applied intermittently to a suitably prepared area of porous land, having its surface not less than four feet above the water level. A half-acre of suitable land would meet all present needs, and the examinations made indicate that this can be found beyond Hodges' canning factory. The disposal of sewage and of manufacturing wastes in accordance with the plan here advised has been practised at Medfield for three years.

Gardner. The selectmen of Gardner applied to the Board for its advice relative to the sewage disposal of that town (Sept. 23 and Oct. 24, 1889), and the Board made the following reply: —

Boston, Nov. 8, 1889.

The discharge of the sewage of the town into Pond Brook would pollute the waters of this stream, so that it would be practically an open sewer. Even if the sewage were discharged directly into Otter River, instead of into the brook, the dilution of the sewage by the summer flow of the stream would be insufficient to prevent a nuisance at villages farther down this river, particularly in the vicinity of mill ponds. It will be observed that the objection to this method of sewage disposal is not dependent upon the subsequent use of the water of the streams affected for water supply purposes.

The sewage should be purified before being turned into either of these streams; and the method of purification best adapted to the conditions existing at Gardner, is intermittent downward filtration through porous land. It appears, from the information

furnished relative to the land on the south-westerly side of Broadway west of Pond Brook, that a sufficient filtration area might be prepared here, at a reasonable expense, to dispose of the sewage from a population double that of the town at present. The preparation of this land for filtration might be accomplished by removing sand and gravel from the upper portion of the ridge, and spreading it to a depth of not less than two and one-half feet over the lower land. After suitable preparation of the surfaces thus formed to permit the sewage to be evenly distributed, fifty thousand gallons might be purified per acre per day on the higher portions, and a somewhat smaller quantity, depending upon circumstances, upon the areas prepared by filling.

In preparing a filtration area to dispose of the sewage from the Parker Street outlet, the sewer should be built high enough to permit the surface of this area to be five feet above the water level in the ground.

MARLBOROUGH. By the terms of chapter 312 of the Acts of 1888, the town of Marlborough was authorized to lay out, construct and maintain a system of sewerage and sewage disposal. Acting under the provisions of the same act, the town submitted a plan to the State Board of Health (Sept. 24, 1889). The State Board, acting in compliance with the provisions of section 2 of the same act, held a public hearing (Oct. 18, 1889), after due notice had been given, at which hearing the sewerage committee of Marlborough and the Water Board of the city of Boston were both represented.

Since the plan which was presented involved such disposal of the sewage as would allow a portion of the effluent to pass into the Boston water supply, the hearing was adjourned in order that the question might be more fully considered by the city of Boston. An amended plan was presented Dec. 20, 1889, and notice issued for another hearing, to be held Jan. 7, 1890. After this hearing the following reply was sent to the authorities of Marlborough: —

BOSTON, Jan. 9, 1890.

In response to your application, made Sept. 24, 1889, under the authority of chapter 312 of the Acts of 1888, relative to the introduction of a system of sewerage and sewage disposal in the town of Marlborough, the State Board of Health has caused examinations to be made by its engineer of the two locations pro-

posed by you for disposing of the sewage, and has given all the plans submitted careful consideration.

After a hearing, held on Oct. 18, 1889, to consider the plan first submitted, at which hearing representatives of the town of Marlborough and the city of Boston were present, it was voted, on the suggestion of the city of Boston, that the hearing be adjourned until the results of further investigations had been presented. As a result of these investigations, a system of sewerage and sewage disposal, described in a communication from M. M. Tidd, engineer for the town of Marlborough, and represented on four plans accompanying said communication, has been submitted. This system of sewerage and sewage disposal was the subject of another hearing, held Jan. 7, 1890, at the office of the State Board of Health in Boston, after fourteen days' notice by said Board of the presentation to it of said system for its approval, by a publication of such notice in the "Boston Journal" and the Marlborough newspapers.

The Board having given the hearing required by the act, and having carefully examined and considered the plans submitted, hereby approves the system of sewerage and sewage disposal and the location thereof, as indicated upon the plans last submitted and hereinbefore described.

Recommendations.

The results of examinations of all the public water supplies of the State, made in the two years previous to June, 1889, are now in the hands of the State printers, and will soon be published. Some of these supplies were found to be of so good quality and so constant in character that their monthly examination was discontinued. Many, however, of doubtful or variable quality, have been examined monthly to the present time; and some, changing frequently in consequence of vegetable growth and death, and changes in the season, have been examined both chemically and biologically, at much shorter intervals, in order to determine the causes of the changes, and to learn what can be done to guard against the evil consequences which often follow these changes. The Board recommends that this study of the waters of doubtful and changing quality be continued through the coming year, and that experiments upon intermittent filtration of surface waters be continued.

The Bhard has found that some of the wells in our towns

and cities, which are used by the public, especially in hot weather, when the water is colder than that of the public supply, are very much polluted by sewage. Some have been found in which the water appears to be merely filtered sewage, and not so well filtered, nor as pure, as the effluent from some of the sewage filters at the Lawrence experimental station, where the supply, entirely from a city sewer, is filtered through a depth of five feet of sand. The Board recommends that examinations be made, during the coming year, of such wells used by the public as may be regarded as liable to be injurious to the public health.

The results of experiments at the Lawrence experimental station, for the two years up to November, 1889, upon the purification of sewage by filtration, and its clarification by chemical precipitation, are now in course of publication. They form important additions to the knowledge of the world upon these subjects, and the Board recommends the continuance of these experiments.

For these purposes, and to make the necessary investigations in order to advise cities, towns, corporations and individuals in regard to the best method of assuring the purity of intended or existing water supplies, and the best method of disposing of sewage, and to carry out the other provisions of chapter 375 of the Acts of 1888, the Board estimates that the sum of twenty-seven thousand dollars will be required.

HENRY P. WALCOTT.
HIRAM F. MILLS.
FRANK W. DRAPER.
ELIJAH U. JONES.
THORNTON K. LOTHROP.
JULIUS H. APPLETON.
JOSEPH W. HASTINGS.

FOOD AND DRUG INSPECTION.

FOOD AND DRUG INSPECTION.

The operations of the Board under the provisions of the food and drugs acts, enacted in 1882, 1883 and 1884, will be found detailed in the following report. The present report embraces the period ending with Oct. 1, 1889.

Many of the special points relative to the supervision of the work conducted under those acts, and also certain facts relating to special articles of food which have come to the notice of the Board on different occasions, have already been detailed in previous reports upon this subject, and hence they will not be repeated in this report.

The following are the analysts and inspectors at present engaged in this department of the work of the Board: —

Dr. BENNETT F. DAVENPORT,	*Analyst.*
Dr. CHARLES HARRINGTON,	*Analyst.*
Dr. CHARLES P. WORCESTER,	*Analyst.*
Prof. CHARLES A. GOESSMANN,	*Analyst.*
JOHN H. TERRY,	*Inspector.*
JOHN F. MCCAFFREY,	*Inspector.*
HORACE F. DAVIS,	*Inspector.*

The whole number of samples of food and drugs examined during the year ending Sept. 30, 1889, was 5,454, which was greater than that of any previous year except 1888, the excess in that year being due to the work done under the provisions of the resolve relative to oleomargarine, ordered by the Legislature of 1887. The increase in the cost of the execution of these statutes in 1889 was due to the employment of an additional inspector for a part of the year, and the increase in the cost of analysis of each sample was due largely to the fact that much more time was spent during the year in the investigation of special cases, and the

preparation of complaints at court, the number of the latter being more than double that of any previous year. The experience of the inspectors in this line of work has year after year involved less of mere inquiry, and partaken more of the character of executive work, so that the actual protection secured to the people becomes greater as the work progresses. New forms of adulteration are frequently met with, and require special inquiry.

The following summary presents the principal data relative to the number of samples of food and of drugs examined for the year ending Sept. 30, 1889, together with the number of each sort found to be adulterated, the number free from adulteration or conforming to the legal standard, and the percentage of adulteration of each class and of the whole.

Number of samples of food examined,	4,854
" " found to be pure,	3,213
" " adulterated, or not conforming to the statutes,	1,641
Percentage of adulteration,	33.8
Number of samples of milk (included above),	3,219
" " " above standard,	1,971
" " " below standard, or otherwise adulterated,	1,248
Percentage of adulteration,	38.7
Number of samples of drugs,	600
" " " of good quality,	503
" " " not conforming to the statutes,	97
Percentage of adulteration,	16.2
Total examinations of food and drugs,	5,454
" " of good quality,	3,716
" " not conforming to the statutes,	1,738
Percentage of adulteration,	31.9

A further summary is also presented, for the purpose of comparison with the work of previous years: —

SUMMARY.	Years.							Total.
	1883.	1884.	1885.	1886.	1887.	1888.	1889.	
Number of samples of food examined,	695	1,962	3,771	3,438	4,870	4,904	4,854	24,494
" " found to be pure,	363	779	2,180	2,186	3,163	3,385	3,213	15,269
" " found to be adulterated or not conforming to the statutes,	332	1,183	1,591	1,252	1,707	1,519	1,641	9,225
Percentage of adulteration,	47.8	60.3	40.3	36.4	35.1	30.9	33.8	37.7
Number of samples of milk examined (included above),	218	1,123	2,219	2,085	3,081	2,825	3,219	14,770
" " " above standard,	35	347	1,297	1,323	1,900	1,705	1,971	8,578
" " " below standard,	183	776	922	762	1,181	1,120	1,248	6,192
Percentage of adulteration,	83.9	69.1	41.7	36.5	38.3	39.6	38.7	41.9
Number of samples of drugs examined,	603	682	1,007	888	550	862	600	5,192
" " of good quality,	357	431	571	463	400	634	503	3,359
" " adulterated, as defined by the statutes,	246	251	436	425	150	228	97	1,833
Percentage of adulteration,	40.8	36.8	43.3	47.8	27.3	26.4	16.2	35.3
Total examinations of food and drugs,	1,298	2,644	4,778	4,326	5,420	5,766	5,454	29,686
" " of good quality,	720	1,210	2,751	2,649	3,563	4,019	3,716	18,628
" " not conforming to the statutes,	578	1,434	2,027	1,677	1,857	1,747	1,738	11,058
Percentage of adulteration,	44.5	54.2	42.4	38.7	34.3	30.3	31.9	37.2
Expense of collection, examination and prosecution,	$2,931 56	$5,529 60	$8,557 43	$8,025 34	$8,803 62	$8,915 41	$10,356 28	$53,119 24
" " " per sample,	2 26	2 09	1 79	1 85	1 62	1 54	1 89	1.79

Food.

The following list comprises the articles of food (excepting milk) which have been examined during the year. The numbers of different articles named in this list differ widely, since it has been the object of the Board to give special attention to those articles of food preparations which are most liable to adulteration, and are also of considerable importance as articles of food. Hence many important kinds of food scarcely appear in the list, and the ratio of adulterated articles in the list is undoubtedly very much greater than the actual ratio existing among such articles as sold in the markets. In the case of a very few articles, adulteration is to a certain extent an unsettled question; as, for example, in the case of baking powders, a subject to which special attention was given in the report of last year.

The following list comprises the articles of food, exclusive of milk, which were obtained by the inspectors during the year, and submitted to analysis: —

	Total.	Genuine.	Adulterated.		Total.	Genuine.	Adulterated.
Allspice,	24	21	3	Extract of lemon,	2	2	–
Baking powders,	23	4	19	Lemon juice,	12	–	12
Bread,	1	1	–	Mace,	14	12	2
Butter and oleomargarine,	211	150	61	Maple sugar,	33	25	8
Cake,	1	1	–	Maple syrup,	89	47	42
Candy,	16	16	–	Molasses,	192	166	26
Canned peas,	1	1	–	Mustard,	61	39	22
Cassia,	146	138	8	Nutmeg,	3	3	–
Cayenne,	24	19	5	Pepper, black,	103	78	25
Celery salt,	1	1	–	Pepper, white,	66	51	15
Cheese,	18	18	–	Pimento,	5	4	1
Cider jelly,	3	3	–	Olive oil,	22	8	14
Currant jelly,	1	–	1	Fruit pudding,	3	3	–
Cloves,	134	116	18	Salad oil,	1	1	–
Cocoa,	6	4	2	Salt,	1	1	–
Coffee,	16	16	–	Savory,	1	1	–
Cream of tartar,	185	163	22	Soda,	15	15	–
Curry,	2	2	–	Sugar,	16	16	–
Gelatine,	2	2	–	Tea,	50	50	–
Ginger,	85	81	4	Vinegar,	100	39	61
Honey,	53	32	21	White oats,	1	1	–
Horseradish,	3	3	–				
Lard,	4	3	1	Total,	1,750	1,357	393

Oleomargarine.

A considerable share of the work of food inspection during the year has been devoted to oleomargarine, and the entire time of one inspector for several months was given

to this article of food. As will be seen in a later portion of this report, the number of complaints entered against offenders was much greater than that of any previous year, the whole number of prosecutions being 53, of which 47, or 89 per cent., resulted in conviction. Since the licensed dealers (of whom there were 460 in Massachusetts in 1889) are to be found only in the cities and large towns, very little is found in the small towns. The complaints entered in 1889 were distributed throughout the State in twenty-five cities and large towns. These undoubtedly have had a very marked influence in preventing fraudulent sales, and in limiting the sale of oleomargarine to its legitimate sale under the provisions of the statutes.

The following summary is taken from the report of the Commissioner of Internal Revenue for the fiscal year ending with June 30, 1889: —

	Pounds.
Average monthly production during the year, in the United States,	2,972,002
Average monthly production in the previous year,	2,860,460
Amount produced during the year in the United States,	35,664,026
Amount produced during the previous year,	34,325,527
Oleomargarine produced in Massachusetts in the year ending June 30, 1889,	561,143
Oleomargarine produced in Massachusetts in the year ending June 30, 1888,	657,712

Revenue.

Tax on oleomargarine (in Massachusetts) during the year ending June 30, 1889, at 2 cents per pound,	$10,334 66
Manufacturers' tax,	600 00
Retail dealers,	17,984 00
Wholesale dealers,	11,620 00
Total,	$40,538 66

The direct tax, as compared with that of Massachusetts, was greater in Connecticut,* Illinois, Indiana, Kansas and Ohio. The tax on retail dealers was greater only in Illinois, while that upon wholesale dealers was greater in Massachusetts than in any other State.

The number of manufacturers in Massachusetts in 1889

* The Connecticut district includes Rhode Island.

was 1; of wholesale dealers, 29 (or four more than those of 1888); and of retail dealers, 460, or 55 more than those of 1888.

Glucose.

The increasing use of this article as an ingredient or adulterant of food preparations calls for special comment upon it, in connection with the work of food inspection. As in the case of many other modern adulterants, the objections to its use do not arise from sanitary so much as from commercial considerations. It is true that injurious chemicals, such as sulphuric acid and lime, are employed in its manufacture; but when it is properly prepared, these do not exist to an appreciable degree in the product. The principal objection consists in the fraudulent substitution of this cheaper article for one of a greater commercial, if not a greater nutritious, value.

Glucose is met with in a variety of articles, in which it is made to replace other kinds of sugar. The principal articles in which it is to be found are cane and maple syrups, molasses, honey, jellies and jams, confectionery and beer. Some of these articles have at least a tolerably well-defined standard of purity; for example, honey is defined as a product of the bee, and, when other ingredients are mixed with it, the compound, if sold as honey and not labelled as a compound, has been regarded by the courts as adulterated, within the meaning of the food acts.

In the case of confectionery, glucose is not regarded, at least in the opinion of manufacturers, as an adulterant, but is largely used by them, and is advertised for such purposes in the trade journals. The explanation of this may possibly be found in the fact that confectionery is in most of its forms a compound, the ingredients being quite numerous. Sugar, starch, chocolate, fats, natural and artificial flavors and coloring matter, together with glucose and occasionally terra alba, enter into the composition of confectionery. The use of terra alba and of poisonous colors is specially regarded as harmful, and is forbidden by the National Association of Confectioners.

As met with in commerce, glucose may be found in the

solid form, and in the form of a clear, transparent syrup. It differs from cane syrup in being much less sweet.

With reference to its use as an ingredient of syrups and of beer, Battershall says of it: —

The question of the sanitary effects of the use of artificial glucose as an adulterant of sugar and syrups, and as a substitute for malted grain in the manufacture of beer, has given rise to extensive controversy. In this regard one fact seems to have been demonstrated. Glucose, as it is now found in the market, is free from any appreciable amount of deleterious contamination. The discovery of its artificial production has given birth to a very important branch of industry, and, according to all available reports, the commercial product at present met with is for many purposes an economical and harmless substitute for cane sugar, the chief objection to its application as such being the fact that it possesses considerably less sweetening power.*

In 1882, in consequence of the presentation of a bill in Congress "to tax and regulate the manufacture and sale of glucose," the Commissioner of Internal Revenue requested the National Academy of Sciences to "examine the composition, nature and properties" of glucose, and also to report upon its saccharine quality as compared with cane sugar, and also as to its deleterious effects in food or drink. From the report of the Academy, which was published in 1884, the following extracts are made: —

The starch sugar of commerce consists chiefly of dextrose, with varying quantities of another kind of sugar called maltose, and often more or less of dextrine or starch gum. Dextrose was first recognized as a peculiar variety of sugar, differing from cane sugar, by Lowitz, in 1792. It is generally known in chemical works as dextrose or dextro-glucose, but is also called glucose, glycose, grape sugar, starch sugar, potato sugar, etc. It is produced from starch by the action of dilute acids. In France and Germany potato starch constitutes the only available material for the manufacture of this sugar, but in the United States the starch of Indian corn or maize is invariably employed. The process consists, first, in extracting the starch from the corn in a state of

* Food Adulteration, and its Detection, by J. P. Battershall, New York, 1887 page 138.

sufficient purity, then transforming this into sugar by treatment with dilute acid, and subsequently neutralizing the acid, purifying, and then concentrating the product.

The various processes of manufacture are briefly described as follows: —

1. *Steeping.* — The corn is steeped in hot water in large tanks, the temperature of the water being 160° in summer, and 185° in winter. The corn reduces the temperature of the water to 140° or 145°. This water is replaced every six hours by fresh water, at 130° or 135° F., and oftener if fermentation appears. From two to four days are required, the time depending on the hardness of the corn.

2. *Grinding.* — The softened corn is ground, a stream of water running continuously into the mill. The thin paste is carried upon the shakers or sieves.

3. *Separation of Starch.* — The paste or pulp is passed over shakers, or inclined sieves of silk bolting cloth, which are kept in motion, and are sprayed with water. The starch passes through the bolting cloth as a milky fluid, leaving the coarse residue behind. This is pressed, and sold as cattle food.

4. *Cleansing.* — The water from the shakers, holding the starch in suspension, is run either directly upon the tables or into wooden vats, in which the starch settles and the water is drawn off and discarded. The starch is next agitated with fresh water, to which a small quantity of caustic soda has been added.

5. *Collecting the Starch.* — The mixture of starch and alkaline water is allowed to flow upon long tables, which are slightly inclined, so that the starch is deposited, while the liquid flows off at the lower end. The alkali is added after the starch has been collected on the runs, and sometimes both before and after.

6. *Washing the Starch.* — The starch is then shovelled up and mixed with water, and again allowed to settle. This process is repeated, and the thoroughly purified starch is finally mixed with water for the converter. The yield varies. A fair average would be, per bushel: —

	Pounds.
Starch,	30
Cattle food,	14
Waste,	12
Total,	56

Transforming the Starch into Sugar.

7. *Conversion*, as it is called, is conducted in either open or closed converters. In some factories it is partly done in open,

and finished in closed converters. These are wooden vats, sufficient for the treatment of the starch of one thousand bushels of corn. They are provided with banks of copper steam coils, either closed or perforated. Sulphuric acid is generally employed in the conversion, though other acids have been used. The quantity employed varies from one-half pound to one and one-quarter pounds per one hundred pounds of starch. In open converters a few inches of water are introduced and the acid added. This acid water is brought to the boiling point, and the starch, previously mixed with water, is slowly pumped in, the liquid being kept constantly boiling. The whole is boiled until the iodine test ceases to give a blue, and shows a dark cherry or an orange, color. The boiling is continued from two to four hours. In closed converters, the starch is mixed with water, and the acid and the whole heated under a pressure of from twenty-five to seventy-five pounds per square inch. The time required for conversion is much shorter than in the open converters.

8. *Neutralization.* — When the starch has been sufficiently converted for the desired product, the liquor is run into the neutralizing vats. Here a sufficient quantity of marble dust is added to completely neutralize the sulphuric acid. In some cases the neutralization is completed with whiting. A little fine bone-black is added, just before and after neutralizing. It is then allowed to cool, and to deposit the sulphate of lime, a minute quantity of which is found in the finished product.

9. *Further Processes.* — The liquor is next filtered through bag filters of cotton cloth, or filter presses, or both. In many establishments treatment with sulphurous acid gas is employed at this stage, to prevent fermentation, and also as a bleaching agent. The liquor is then passed through bone-black filters, by which it is decolorized, and freed from other soluble impurities. Concentration is then effected in a vacuum pan, at a temperature of 130° to 140° F. During this concentration a quantity of sulphate of lime separates, and is removed by further filtration through bags or filter presses. A second treatment with sulphurous acid and bone-black filtration follows; and the final concentration is accomplished by boiling, and a third filtration is effected, to remove more of the sulphate of lime. All of these steps are followed only by those makers who desire to secure the best product. The variety in which the conversion is the least complete is called "glucose," and remains liquid. That in which it is more complete, and which becomes solid, is called "grape sugar." Starch sugar appears in commerce in a variety of grades, under the following names: —

(*a*) *The Liquid Varieties.*

Glucose.	Corn syrup.
Mixing glucose.	Jelly glucose.
Mixing syrup.	Confectioners' crystal glucose.

(*b*) *The Solid Varieties.*

Solid grape sugar.	Powdered grape sugar.
Clipped grape sugar.	Confectioners' sugar.
Granulated grape sugar.	Brewers' grape sugar.

This industry sprang into existence during the continental blockade under Napoleon I., after which it disappeared for some years. It has gradually revived, and is now an established industry, both in continental Europe and in the United States. The irregularity of demand for the product depends largely upon the comparative price of corn, and of molasses and cane sugar. At the time of the last census, the capacity of the factories in the United States was estimated at 43,000 bushels of corn per day. Payen, in 1855, estimated the French production from potato starch at 5,500 tons per year; and Wagner, in 1874, estimated that of the German Empire at 19,800 tons of syrup and 27,500 tons of sugar per year.

Uses of Glucose or Starch Sugar.

The chief uses of this substance are as a substitute for cane sugar, or for barley (as in beer).

1. For the manufacture of table syrup. For this purpose a nearly or quite colorless glucose is used, with a sufficient addition of cane syrup to give it the flavor and appearance of a refined molasses.

2. As a substitute for barley malt in the brewing of ale or beer. This is an imperfect substitution of Indian corn for barley; the corn, by the treatment employed in extracting its starch for conversion into glucose, being completely deprived of all the nitrogenous bodies and mineral salts which it originally contained. Hence the glucose, or transformed starch, is substituted for the barley grain, with its great variety of valuable constituents.

3. As a substitute for cane sugar in confectionery.

4. For the adulteration of cane sugar. (Actual inspection does not show that this is of frequent occurrence.)

5. As a substitute for sugar in the canning of fruits and the manufacture of fruit jellies.

6. For the manufacture of artificial honey.

7. In the manufacture of vinegar.

8. In the manufacture of artificial liquors.

9. It has other limited uses: in the manufacture of wine; by bakers, in the making of cakes; in the preparation of sauces; as an addition to canned meats; in the preparation of chewing tobacco; and in the manufacture of printers' rollers, and certain kinds of ink. It has from two-fifths to three-fifths the sweetening power of cane sugar.

Is the Use of "Glucose" injurious to Health?

Upon this point the results of early experiments appear to have been of a conflicting nature. These experiments, however, of Schmitz, Nessler and von Bering, were all made with potato sugar. Those which were made for the National Academy of Sciences, by Dr. Duggan of Johns Hopkins University, were made with maize sugar, and occupied a period of about two months. The results showed that "there was nothing whatever to indicate that the extracts contained anything injurious to health; and the conclusion seems to be fully justified that the samples examined by us, and which we have every reason to believe were fair average samples of the substances found in the market, contained nothing objectionable, from a sanitary stand-point."

The committee reported the following conclusions: —

1. That the manufacture of sugar from starch is a long-established industry, scientifically valuable and commercially important.
2. That the processes which it employs at the present time are unobjectionable in their character, and leave the products uncontaminated.
3. That the starch sugar thus made and sent into commerce is of exceptional purity and uniformity of composition, and contains no injurious substances.
4. Though having at best only about three-fifths the sweetening power of cane sugar, yet starch sugar is in no way inferior to cane sugar in healthfulness, there being no evidence before the committee that maize-starch sugar, either in its normal condition or fermented, has any deleterious effect upon the system, even when taken in large quantities.

Other Adulterations.

The following lists of articles found to be adulterated are published for the information of consumers. They are taken from Prof. E. Richards' recent report to the Commissioner of Internal Revenue (report of 1889), and comprise such

as have been found to be adulterated by the chemists of the State Board of Health of Massachusetts, by the State Dairy Commissioner of New Jersey, and the Department of Inland Revenue of Canada. To these have been added other articles which have been reported upon by the State Board of Health of Massachusetts.

Baking Powders.

Professor Richards says of these substances or preparations: —

They all administer a medicinal dose, having more or less effect on the human economy, depending on the nature of the ingredients used, from Rochelle salts, where cream of tartar and alkaline bicarbonates are employed, to a strong astringent, where alum is used. They are all sold at an immense profit, even if chemically pure salts were employed, which is seldom the case, the ordinary commercial product answering sufficiently well. No pound sample should cost more than twenty-five cents.

Alum Baking Powders.

A. & P. (Atlantic & Pacific).
Albany Favorite.
American Gilt Edge.
Aunt Sally.
Balloon.
Brooks & McGeorge.
Brunswick Yeast Powder.
Burnett's Perfect.
Can't be Beat.
Capitol.
Centennial.
Challenge.
Choice Crystal.
Cook's Acme.
Cook's Best.
Cook's Best Friend.
Cook's Choice.
Cook's Favorite.
Cook's Finest.
Coral.
Cottage.
Crown.
Crystal.
Daisy.
Davis.
Davis O. K.
Dixon.
Dooley's.
Dry Yeast.
Eclipse.
Enterprise.
Eureka.
Feather-weight.
Fleur de Lis.
Forest City.
Four Aces.
G. A. & P. Tea Company.
Grand Union Tea Company
Gem.
George Washington.
Globe.
Golden Sheaf.
Grape.
Great Eagle.
Henkel.
Higgins.
Holyoke.
Hygienic.

Alum Baking Powders — Concluded.

Ideal.
International.
James' (London).
Kenton.
Liberty.
Lincoln.
London.
Mason's.
McDowell's G. & J.
Miles Prize.
Ne Plus Ultra.
New Era.
Ocean Foam.
Ocean Wave.
Old Colony.
On Top.
One Spoon.
Orange.
Oriole.
Our Own.
Patapsco.
Perfection.
Pride of Ottawa.
Pride of Toronto.
Puritan.
Purity.
Silver Cream.
Silver King.
Silver Queen.
Silver Star.
Silver Thimble.
Snow-drift.
Springfield.
Somerville.
Sovereign.
Standard.
Star.
State.
Superior German.
Vienna.
Welcome.
White Star.
Windsor.

"Package" Coffee and Coffee Extract.

Chief adulterants found: Chicory, peas, beans, rye, corn, wheat, coloring matter: —

American Company's.
Bacon, Stickney & Co.'s.
Blue Seal, Wm. Scull & Co.
Brazil Blended.
Brooks, Brower & Ware.
Chase's.
Eight o'clock Coffee.
Eureka.
Excelsior.
French Breakfast.
G. A. & P. T. Company.
Java Coffee.
Maynard & Irwin.
Medicated.
National, Davis, Silvers & Co.
Newhall's.
None Such.
Old Spanish Hacienda.
Plantation.
Spurr's Breakfast.
Sunrise, Weikel Spice Company.
Swain, Earle & Co..
U. P. T. Company.
Vienna Breakfast.
Emil Seelig's Kaffee (extract, guaranteed pure).
P. C. Thomson, Philadelphia (Coffee essence).

Cream of Tartar.

Chief adulterants: sulphate of lime, acid phosphate of lime, more than six per cent. of tartrate of lime, alum, cornstarch and flour: —

Allyn, Blanchard & Co , Hartford, Conn.,
Bennett & Sloan, New York.
Crescent Mills, Connecticut.
Hope Mills, Providence, R. I.
F. H. Leggett & Co , New York.
Madeira, X, 1848, New York.
Malaga, New York.
Perkins & Perkins.
Quinnipiac Mills, Connecticut.
Saville, Somes & Co.
Springfield Coffee & Spice Co.
Tiger Mills, New York.
XXX First Quality.

Canned Vegetables.

The addition of sulphate of copper in small quantities, to give a green color, seems to be a common practice with these firms : —

Barton Fils, Paris, peas.
Alex. Bernard, Bordeaux, peas.
A. Billet, beans.
Charpentier, Usine de Montrouge, peas.
E. M. Dadelzen, Bordeaux, peas.
Daudicolle & Gaudin, Bordeaux, peas, beans, sprouts.
Duprat, Clement & Maurel, peas.
Alexandre Eyquem, Bordeaux, peas.
J. Fiton Ainè & Cie., Bordeaux, peas.
Fontaine Frères, peas.
Guillaumez, Nancy, peas.
Lanan, Francois & Cie., Bordeaux, peas.
Marcelino, Paris, peas.
Alphonse Pinard, Bordeaux, peas.
Eugene du Raix, Bordeaux, peas.
Rödel & Fils Frères, peas.
F. Rondenet, Nantes, peas.
Soule & Price, Bordeaux, peas.
G. Talbot, Bordeaux, beans.
Victor Tertrais, Nantes, peas.
Gabriel Triat & Cie., Bordeaux, peas.

Lard.

Chief adulterants found: water, beef-stearine, cotton-seed oil : —

Armour & Co., Chicago.
Armour Packing Co., Kansas City.
J. H. Bruggeman, Cincinnati.
Cassard & Son.
Chase & Decker, New York.
Cobb Bros.
T. O. Daniels, Chicago.
N. K. Fairbanks & Co., Chicago.
F. W. Garde & Co., Chicago.
Halstead & Co.
Hall & Cameron.
Hammond & Co., Detroit.
G. L. Lyons.
Rohe Bros.
Wilton, Chicago.
Chas. F. Tietjen, New York.

Olive Oil.

Chief adulterants found: cotton-seed oil, and other vegetable oils : —

Huile d'Olive d'Aix, Beyer Frères, Bordeaux.
F. Cartoux, Nice.
Rudolph Clavalier.
R. L. Dacosini, Nantes, Huile d'Olive Superfine Clarifiée.
R. L. Dacosini, Nice.
Dacosini, Bordeaux.
Ducro & Cie, Aix.
B. Dufour & Cie.
E. Ferrari.
Guillaume, Bordeaux.
S. Larcher, Jeune, Bordeaux.
Lazell, Dalley & Co.
Huile d'Olive Vierge, E. Loubon, Nice.
Mohnoel.
Orient Frères, Bordeaux.
Pure Olive Oil, prepared by J. L. Pynchon.
A. Seguin, Nice.
L. Verona.
Huile d'Olive Vierge d'Aix, Bordeaux.
Superfine Huile d'Olive, Nice.
Huile de Salade, Providence, R. I.

Ground Spices.

Chief adulterants found: flour, starches of various kinds, nut shells, turmeric: —

Ginger.

Casey & Bacon.
E. W. Ropes, New York.
G. W. Yerks, Albany.

Cayenne Pepper.

Bacon, Stickney & Co, Albany.
Casey & Bacon.
E. R. Durkee.
Globe Mills.
New England Coffee & Spice Mills.
F. H. Leggett, New York.
J. W. Sprague, Providence, R. I.
Taylor & Staley, Troy, N. Y.
Tropical Mills.
Union Spice Company, New York.

Allspice.

E. W. Ropes, New York.
Hope Mills.
Bacon, Stickney & Co, Albany.

Mace.

Bugbee & Brownell.
Bacon, Stickney & Co, Albany.
Bennett & Sloan, New York.
Knickerbocker Mills, New York.
F. H. Leggett, New York.
Springfield Coffee & Spice Co.
Taylor & Staley, Troy.
W. J. Stitt & Co., New York.
S. R. Van Duzer, New York.

Mustard.

J B. Anthony, Troy.
Ardenter Mustard.
Austin & Rich, New York.
Bacon, Stickney & Co., Albany.
Blackwell & Co.
Boston Mills.
Colburn's Mustard.
Cole & Frith.
Colman's Mustard.
Crescent Mills, Connecticut.
Curlew & Sons.
Durham Mustard.
E. R. Durkee's Mustard.
Empire Mills.
English Mustard
Golding & Co.
Hope Mills, Providence, R. I.
Imperial.
India Mills, New York.
Judson, Parsons & Haskell, Albany.
Knickerbocker Mills, New York.
London Mustard.
London Extra Strong.
Mather Bros, Albany.
Matthews, Underhill & Co., New York.

Ground Spices — Concluded.

Quinnipiac Mills, Connecticut.
E. W. Ropes & Co , New York.
Russian.
Springfield Coffee & Spice Co.
Spurr's Mustard.
Tiger Mills, New York
Union Spice Company, New York.

Black Pepper.

Allyn & Blanchard, Hartford.
Casey & Bacon.
Colburn's.
Crescent Mills, Connecticut.
E. R. Durkee, New York.
W. Gilbert & Co.
Globe Mills.
Haskell & Adams.
Lester, Providence, R I.
New Bedford Mills.
Windsor Mills. New York.
Quinnipiac Mills, Connecticut.
E. W. Ropes, New York.
J. E. Rounds & Co , Providence, R. I.
Sands', Hartford, Conn.
J. W. Sprague, Providence, R. I.
Springfield Coffee & Spice Co.
Union Spice Company, New York.

White Pepper.

Auger, Tuttle & Co , Connecticut.
E. Howard.
Hope Mills, Providence, R. I.
Narragansett Mills, Providence, R.I.
Springfield Coffee & Spice Co.
Union Spice Company, New York.
Wilson, Pratt & Co., New York.

Cassia.

Allyn & Blanchard, Hartford.
Bacon, Stickney & Co., Albany.
G. K Birdsey, Bridgeport. Conn.
Brunswick Mills, New York.
Crescent Mills, New Haven, Conn.
A. C. Fitzpatrick & Co., New York.
Lyons, Delaney & Co., Providence, R. I.
D. Lester, Providence, R. I.
Massasoit Mills.
E. W. Ropes & Co., New York.
Springfield Coffee & Spice Co.
Union Spice Company, New York.

Cloves.

Bacon, Stickney & Co , Albany.
Capitol City Mills, Tracy & Wilson, Albany.
Crescent Mills, New Haven.
A C. Fitzpatrick & Co , New York.
Lester's, Providence, R. I.
Narragansett Mills, Providence, R I.

Cocoa.

Rockwood & Co., New York.

Honey.

Chief adulterant: glucose syrup.

T. Aborn & Co., Boston & Hyde Park.
Austin, Nichols & Co., New York.
Pure White Clover Honey, Dillon Bros , Medford.
J. H. Dodge.
Pure Florida Honey, Samuel J. Geer, South Boston.
White Clover Honey, Samuel J. Geer, South Boston.
David H. Geer.
Pure Honey, H. D. Gloyd.

Pure Vermont Honey, W. J. Lamb, Medford.
Orange Blossom Honey, F. C. Strohmeyer, New York.
Pure White Clover Honey, A. J. Raymond, Boston.
Pure Strained Honey.
Hildreth Bros. & Segelken.
Mohawk Valley, particularly for medical use.

Maple Syrup.

Chief adulterant: glucose syrup: —

F. P. Adams & Co , Boston.
Boyd's Green Mountain.
Curtice Bros., Rochester, N. Y.
Sam'l J. Geer, Medford.
David H. Geer, South Boston.
H. D. Gloyd.
W. J. Lamb, Medford.
Lord & Carlisle, Medford.
Pure Maple Syrup, Morristown, Vt.
Pure Rock Maple, Woodstock, Vt.
Greensboro', Vt.
Wilmington, Vt.
Rochester, Vt.
Orange County, Vt.
A. J. Raymond, Everett.
Bidwell & Langdon, Monterey.

Lemon Juice.

F. P. Adams & Co., Boston.
Houghton & Dutton, Boston.
H. H. Wetherbee, Boston.

Articles of Food found to be adulterated and for which Notices were sent.

Allspice,	3	Mace,	2
Cassia,	8	Maple sugar,	6
Cayenne,	5	Maple syrup,	25
Cloves,	17	Molasses,	18
Cocoa,	2	Mustard,	20
Cream of tartar,	21	Olive oil,	14
Currant jelly,	1	Pepper, black,	22
Ginger,	4	Pepper, white,	13
Honey,	21	Pimento,	1
Lemon juice,	11	Vinegar,	19

Cities and Towns to which Notices were sent on Account of Adulterated Articles of Food.

Adams,	1	Clinton,	2
Amesbury,	1	Danvers,	1
Amherst,	1	Dedham,	1
Athol,	2	Fall River,	26
Ashland,	1	Fayville,	1
Boston,	76	Gloucester,	5
Beverly,	1	Haverhill,	1
Cambridge,	5	Holyoke,	7

Cities and Towns to which Notices were sent, etc. — Concluded.

Hopkinton,	2	Pittsfield,	2
Hyde Park,	1	Plymouth,	2
Lenox,	5	Provincetown,	1
Lawrence,	4	Quincy,	4
Lowell,	15	Salem,	2
Marlborough,	3	Somerville,	1
Melrose,	2	South Framingham,	1
Milford,	1	Spencer,	1
Millbury,	3	Springfield,	8
Nantucket,	1	Taunton,	5
Newburyport,	2	Turner's Falls,	3
North Adams,	9	Westborough,	1
Northampton,	2	Westfield,	4
North Attleborough,	2	Woburn,	2
Palmer,	2	Worcester,	9

Milk.

The examination of milk in the different cities and large towns of the State, where milk is offered for sale to consumers, was continued throughout the year, with the results which are shown in the appended tables.

It has been the custom of the Board to separate the work of milk inspection into two districts, as a matter of convenience, the four western counties comprising the smaller district, and the remaining counties the larger district. The examination of the commercial milk of these two districts during the past year shows, as usual, a very marked difference in quality in favor of the smaller district, a similar difference having been shown during each of the previous years of inspection. It is, in fact, a very rare occurrence to find a sample of milk offered for sale west of Worcester County which falls much below the statute limit of thirteen per cent. of total solids.

The large percentage of milk found on examination to be below the standard should not be taken as a true index of the actual amount of existing adulteration of this important article of food, since special pains are taken to ascertain the actual offenders. In the case of some of the towns, for example, which are enumerated in the following list, but little milk is sold at retail, as compared with that which is sent to market in the cities; and the samples reported from

those towns are usually such as are taken direct from producers suspected of adulterating milk. For example: 6 samples in Ashland, 4 in Carlisle, and 3 in Chelmsford, of which all were found to be adulterated; 12 in Dracut, of which 10 were found to be adulterated; etc. These represented but four or five dairies only, since several samples were obtained from each, usually one from each can exposed for sale. These very large percentages of adulteration in single instances have a marked effect in increasing the general percentage of the whole list.

The great importance of milk as an article of food; its rapid deterioration upon exposure to the air, especially at high temperatures; its liability to convey the material of infection, — make it imperative that its production and its sale should be conducted under the most careful supervision; and, on this account, the Board has recently issued a circular relative to this subject, which has been distributed liberally throughout the State. A copy of this circular is included in the general report of the Board.

Milk of Cities.

The following summary is presented of the results of inspection of the milk obtained in the cities of Massachusetts during the year ending Sept. 30, 1889. These samples were all obtained from retailers, selling from wagons or from shops.

Boston.

Number of samples received,	542
above standard,	305
below standard,	237
Skimmed,	14
Colored,	18
Lowest sample (total solids),	8.84
Percentage below standard,	43.72

Lowell.

Number of samples received,	117
above standard,	71
below standard,	46
Skimmed,	2
Lowest (total solids),	8.58
Percentage below standard,	39.31

Worcester.

Number of samples received,	94
above standard,	58
below standard,	36
Skimmed,	1
Lowest,	10.56
Percentage below standard,	38.29

Cambridge.

Number of samples received,	210
above standard,	79
below standard,	131
Skimmed,	1
Lowest,	9.32
Percentage below standard,	62.38

Fall River.

Number of samples received,	164
above standard,	108
below standard,	56
Colored,	9
Lowest,	5.46
Percentage below standard,	34.14

Lynn.

Number of samples received,	70
above standard,	38
below standard,	32
Lowest,	10.40
Percentage below standard,	45.71

Lawrence.

Number of samples received,	57
above standard,	36
below standard,	21
Skimmed,	2
Lowest,	11.32
Percentage below standard,	36.84

New Bedford.

Number of samples received,	15
above standard,	15
Lowest,	12.56

Somerville.

Number of samples received,	57
above standard,	17
below standard,	40
Colored,	2
Lowest,	10.72
Percentage below standard,	70.17

Salem.

Number of samples received,	46
above standard,	25
below standard,	21
Lowest,	10.71
Percentage below standard,	45.65

Chelsea.

Number of samples received,	68
above standard,	40
below standard,	28
Lowest,	9.55
Percentage below standard,	41.16

Taunton.

Number of samples received,	50
above standard,	42
below standard,	8
Skimmed,	1
Lowest,	11.28
Percentage below standard,	16.00

Haverhill.

Number of samples received,	71
above standard,	38
below standard,	33
Lowest,	10.35
Percentage below standard,	46.48

Gloucester.

Number of samples received,	47
above standard,	33
below standard,	14
Lowest,	9.45
Percentage below standard,	29.78

Brockton.

Number of samples received,	36
above standard,	29
below standard,	7
Skimmed,	1
Lowest,	10.43
Percentage below standard,	19.44

Newton.

Number of samples received,	75
above standard,	36
below standard,	39
Colored,	4
Lowest,	11.00
Percentage below standard,	52.00

Malden.

Number of samples received,	37
above standard,	17
below standard,	20
Lowest,	9.75
Percentage below standard,	54.05

Fitchburg.

Number of samples received,	15
above standard,	13
below standard,	2
Lowest,	12.00
Percentage below standard,	13.33

Waltham.

Number of samples received,	44
above standard,	23
below standard,	21
Lowest,	10.20
Percentage below standard,	47.72

Newburyport.

Number of samples received,	35
above standard,	20
below standard,	15
Lowest,	12.24
Percentage below standard,	42.85

Woburn.

Number of samples received,	19
above standard,	12
below standard,	7
Lowest,	11.89
Percentage below standard,	36.84

Quincy.

Number of samples received,	86
above standard,	53
below standard,	33
Skimmed,	3
Colored,	1
Lowest,	9.24
Percentage below standard,	38.37

Summary.

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.	Colored.
Boston,	542	305	237	43.72	14	18
Lowell,	117	71	46	39.31	2	–
Worcester,	94	58	36	38.29	1	–
Cambridge,	210	79	131	62.38	1	–
Fall River,	164	108	56	34.14	–	9
Lynn,	70	38	32	45.71	–	–
Lawrence,	57	36	21	36.84	2	–
New Bedford,	15	15	–	–	–	–
Somerville,	57	17	40	70.17	–	2
Salem,	46	25	21	45.65	–	–
Chelsea,	68	40	28	41.16	–	–
Taunton,	50	42	8	16.00	1	–
Haverhill,	71	38	33	46.48	–	–
Gloucester,	47	33	14	29.78	–	–
Brockton,	36	29	7	19.44	1	–
Newton,	75	36	39	52.00	–	4
Malden,	37	17	20	54.05	–	–
Fitchburg,	15	13	2	13.33	–	–
Waltham,	44	23	21	47.72	–	–
Newburyport,	35	20	15	42.85	–	–
Quincy,	86	53	33	38.37	3	1
Woburn,	19	12	7	36.84	–	–
	1,955	1,108	847	43.32	25	34

Milk of Towns.

The following list comprises the samples of milk obtained in the towns. Some of these, especially those which were obtained in the small farming towns, were from producers suspected of milk adulteration.

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.	Colored.
Amesbury,	10	8	2	20.00	–	–
Andover,	4	2	2	50.00	–	–
Athol,	9	5	4	44.44	–	–
Ashland,	6	–	6	100.00	–	–
Ayer,	9	7	2	22.22	–	–
Beverly,	19	9	10	52.63	–	–
Brookline,	58	43	15	25.86	1	–
Carlisle,	4	–	4	100.00	–	–
Chelmsford,	3	–	3	100.00	–	–
Clinton,	12	9	3	25.00	–	–
Danvers,	8	4	4	50.00	–	–
Dedham,	31	11	20	64.51	–	–
Dover,	7	6	1	14.28	–	–
Dracut,	12	2	10	83.33	–	–
East Deerfield,	6	1	5	83.33	–	–
Fayville,	14	6	8	57.14	–	–
Franklin,	18	17	1	5.55	1	–
Grafton,	6	6	–	–	–	–
Groton,	5	1	4	80.00	–	–
Harvard,	13	1	12	92.30	–	–
Holliston,	16	2	14	87.50	–	–
Hopkinton,	12	2	10	83.33	–	–
Hubbardston,	12	1	11	91.66	–	–
Hull,	4	2	2	50.00	–	–
Hyde Park,	12	5	7	58.33	–	–
Lexington,	8	–	8	100.00	–	–
Lincoln,	7	1	6	85.71	–	–
Littleton,	3	1	2	66.66	–	–

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.	Colored.
Marlborough,	24	19	5	20.83	3	–
Medford,	8	5	3	37.50	–	–
Melrose,	10	6	4	40.00	–	–
Milford,	12	10	2	16.66	1	–
Millbury,	12	9	3	25.00	–	–
Nantasket,	6	4	2	33.33	–	–
Natick,	57	37	20	35.08	4	–
Nantucket,	10	9	1	10.00	–	–
Needham,	12	8	4	33.33	–	–
Norfolk,	6	6	–	–	–	–
Northborough,	12	8	4	33.33	–	–
Plymouth,	23	17	6	26.09	–	–
Provincetown,	12	7	5	41.66	–	–
Randolph,	18	15	3	16.66	–	–
Revere,	75	45	30	40.00	1	–
Saxonville,	6	3	3	50.00	–	–
Somerset,	9	3	6	66.66	–	–
South Framingham,	27	19	8	29.62	–	–
Spencer,	12	10	2	16.66	–	–
Stoneham,	14	11	3	21.42	–	–
Watertown,	10	6	4	40.00	–	–
Wayland,	8	8	–	–	–	–
Wenham,	12	3	9	75.00	–	–
Westborough,	42	22	20	47.62	2	–
West Medway,	4	1	3	75.00	–	–
Weston,	17	8	9	52.94	–	–
Weymouth,	6	6	–	–	–	–
Winchester,	12	3	9	75.00	–	4
Winthrop,	22	9	13	59.09	–	–
Eastern Massachusetts, Towns,	826	469	357	43.22	13	4
Eastern Massachusetts, Cities,	1,955	1,108	847	43.34	25	34
Western Massachusetts,	300	247	53	17.66	7	–
Total,	3,081	1,824	1,257	40.80	45	38

Cities and Towns to which Notices were sent on Account of Adulterated Milk.

Adams,	1	Northampton,	1
Andover,	1	Pittsfield,	4
Athol,	2	Plymouth,	4
Boston,	60	Provincetown,	4
Brockton,	2	Quincy,	11
Brookline,	2	Randolph,	2
Cambridge,	29	Revere,	10
Carlisle,	1	Saxonville,	1
Chelsea,	9	Somerset,	2
Chicopee Falls,	1	Salem,	5
Clinton,	1	Somerville,	15
Danvers,	1	South Framingham,	2
Fall River,	2	Spencer,	1
Franklin,	1	Springfield,	3
Gloucester,	7	Taunton,	1
Haverhill,	6	Turner's Falls,	3
Hopkinton,	3	Waltham,	3
Holyoke,	3	Ware,	1
Hull,	1	Watertown,	2
Hyde Park,	1	Wenham,	1
Lawrence,	7	Westborough,	1
Lowell,	16	Westfield,	2
Lynn,	9	Weston,	3
Malden,	7	Winchester,	8
Melrose,	1	Winthrop,	2
Natick,	3	Worcester,	6
Newton,	10		
North Adams	3	Total,	288

Milk of Known Purity.

During the several years in which the Board has been entrusted with the execution of the food and drug acts, examinations have occasionally been made of the milk of animals, as produced throughout the State. These examinations have been made with reference to all the varying conditions of breed, of feeding, time of year and age of animal. The milk of six hundred and one animals in all was examined in 1884 and 1885, and the results of analysis were published in the report of 1885. The average total solids of the milk of all of these animals was 13.26. Several herds have also been subjected to examination during the past year, with the same object in view. The analyses of the greater part of these samples are presented in the report of Dr. Worcester, and the general result shows a lower average than that which was found in 1884 and 1885. The reasons for this lower average quality may be looked for in two directions, one of which may be properly termed meteorological. The rainfall in Massachusetts during the months of September and October, in which the samples were collected, was considerably greater than the average of the previous ten years. It can hardly be considered as a settled question that this excessive precipitation influenced the quality of growing crops to such an extent as to affect to a considerable degree the quality of milk produced by animals feeding upon such crops. The other condition affords a far more probable cause for an inferior quality of milk; that is, the presence in such herds of an unusual number of Holstein cows, whose milk is usually found to be below the legal standard of pure milk. One herd of animals of mixed breeds has been examined for the purpose of noting the fluctuations in the milk of single animals, during short periods of time. The milk of these animals was examined at average intervals of about a week. It will be noticed that the range of total solids in single animals is found to vary to a considerable degree, in some instances as much as two and one-half per cent. Another herd has also been selected for the purpose of making analyses of the milk once each month for a period of one year. These will be reported upon in the next annual report.

Analysis of Milk of One Herd of Six Cows at Frequent Intervals. (Hopkinton, Mass.)

Cow No. 1. Grade Holstein and Ayrshire; 9 years old; calved in April, 1889. Feed: In October and November, pasturage, ensilage, four quarts shorts; in December, corn stover, English and meadow hay, ensilage, four quarts shorts, with some cob meal and cotton-seed meal.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.	Ash.
Oct. 29, 1889, . . .	–	–	13.20	–	–
Dec. 3, 1889, . . .	–	–	13.66	–	–
Dec. 18, 1889, . . .	–	–	12.00	–	–
Jan. 10, 1890, . . .	2.82	8.74	11.56	88.44	.56
Jan. 14, 1890, . . .	3.14	9.18	12.32	87.68	.60
Jan. 17, 1890, . . .	2.88	9.12	12.00	88.00	.68
Jan. 21, 1890, . . .	2.96	8.74	11.70	88.30	.66
Jan. 24, 1890, . . .	3.36	9.08	12.24	87.76	.64
Jan. 28, 1890, . . .	3.26	9.08	12.34	87.66	.64
Feb. 4, 1890, . . .	–	–	12.64	–	–
Feb. 17, 1890, . . .	–	–	12.64	–	–

Cow No. 2. Grade Jersey; nine years old; calved in May, 1889. Same feed as in No. 1.

Oct. 29, 1889, . . .	–	–	13.94	–	–
Dec. 3, 1889, . . .	–	–	15.34	–	–
Dec. 18, 1889, . . .	–	–	13.90	–	–
Jan. 10, 1890, . . .	4.22	9.66	13.88	86.12	.60
Jan. 14, 1890, . . .	4.08	9.62	13.70	86.30	.66
Jan. 17, 1890, . . .	3.66	10.08	13.74	86.26	.68
Jan. 21, 1890, . . .	3.06	10.22	13.28	86.72	.72
Jan. 24, 1890, . . .	4.40	9.50	13.90	86.10	.56
Jan. 28, 1890, . . .	4.76	9.78	14.54	85.46	.64
Feb. 14, 1890, . . .	–	–	13.10	–	–
Feb. 17, 1890, . . .	–	–	14.42	–	–

Cow No. 3. Native; ten years old; calved in October, 1888. Same feed as in No. 1.

Oct. 29, 1889, . . .	–	–	13.96	–	–
Nov. 13, 1889, . . .	–	–	13.53	–	–
Dec. 3, 1889, . . .	–	–	14.20	–	–
Dec. 18, 1889, . . .	–	–	12.00	–	–
Jan. 10, 1890, . . .	4.00	9.24	13.24	86.76	.60
Jan. 14, 1890, . . .	4.02	9.12	13.14	86.86	.66
Jan. 17, 1890, . . .	3.96	9.20	13.16	86.84	.72
Jan. 21, 1890, . . .	3.74	9.00	12.74	87.26	.64
Jan. 24, 1890, . . .	4.00	9.02	13.02	86.98	.62
Jan. 28, 1890, . . .	4.02	9.36	13.38	86.62	.64
Feb. 4, 1890, . . .	–	–	13.62	–	–
Feb. 17, 1890, . . .	–	–	14.22	–	–

Analysis of Milk, etc. — Concluded.

Cow No. 4. Native; ten years old; calved in October, 1888. Same feed as in No. 1.

Date of Taking Sample.	Fat.	Solids not Fat.	Total Solids.	Water.	Ash.
Oct. 29, 1889, . . .	–	–	12.65	–	–
Nov. 13, 1889, . . .	–	–	11.63	–	–
Dec. 3, 1889, . . .	–	–	12.86	–	–
Jan. 10, 1890, . . .	3.12	8.88	12.00	88.00	.62
Jan. 14, 1890, . . .	2.82	8.60	11.42	88.58	.58
Jan. 17, 1890, . . .	3.14	8.58	11.72	88.28	.72
Jan. 21, 1890, . . .	3.30	8.72	12.02	87.98	.80
Jan. 24, 1890, . . .	3.50	8.94	12.44	87.56	.64
Jan. 28, 1890, . . .	2.80	8.66	11.46	88.54	.56
Feb. 4, 1890, . . .	–	–	12.12	–	–

Cow No. 5. Half Holstein; nine years old; calved in April, 1889. Same feed as in No. 1.

Oct. 29, 1889, . . .	–	–	11.80	–	–
Nov. 13, 1889, . . .	–	–	12.50	–	–
Dec. 3, 1889, . . .	–	–	13.14	–	–
Dec. 18, 1889, . . .	–	–	12.00	–	–
Jan. 10, 1890, . . .	3.66	8.76	12.42	87.58	.56
Jan. 14, 1890, . . .	3.50	9.04	12.54	87.46	.64
Jan. 17, 1890, . . .	3.20	9.50	12.70	87.30	.60
Jan. 21, 1890, . . .	3.60	8.96	12.56	87.44	.76
Jan. 24, 1890, . . .	3.60	9.04	12.64	87.36	.64
Jan. 28, 1890, . . .	3.66	8.94	12.60	87.40	.54
Feb. 17, 1890, . . .	3.50	9.34	12.84	87.16	.60

Cow No. 6. Ayrshire; eight years old; calved in May, 1889. Same feed as in No. 1.

Oct. 29, 1889, . . .	–	–	12.46	–	–
Nov. 13, 1889, . . .	–	–	12.60	–	–
Dec. 3, 1889, . . .	–	–	13.14	–	–
Dec. 18, 1889, . . .	–	–	11.80	–	–
Jan. 10, 1890, . . .	3.22	9.32	12.54	87.46	.70
Jan. 14, 1890, . . .	3.18	8.82	12.00	88.00	.56
Jan. 17, 1890, . . .	3.48	9.00	12.48	87.52	.60
Jan. 21, 1890, . . .	3.40	8.72	12.12	87.88	.62
Jan. 24, 1890, . . .	3.60	9.14	12.74	87.26	.52
Feb. 17, 1890, . . .	3.34	9.14	12.48	87.52	.52

The following are the results of examination of the milk of a herd of twelve Holstein cows taken at Brockton, April 14. These animals were milked at one P.M. Their feed consisted of one quart of gluten meal, five quarts of shorts, four quarts of corn meal, with ensilage and hay.

Age of Cow.	Time since Calving.	Fat.	Solids not Fat.	Total Solids.	Water.
6 years, . .	1 month, . .	3.67	9.20	12.87	87.13
6 years, . .	1¾ months, .	3.65	9.22	12.87	87.13
7 years, . .	1 month, . .	3.33	9.15	12.48	87.52
6 years, . .	1½ months, .	3.36	8.81	12.17	87.83
4 years, . .	– –	4.30	9.87	14.17	85.83
5 years, . .	6 months, .	3.26	8.51	11.77	88.23
11 years, . .	8 months, .	3.96	9.23	13.19	86.81
4 years, . .	6 months, .	4.03	9.67	13.70	86.30
4 years, . .	9 months, .	3.73	9.27	13.00	87.00
6 years, . .	9 months, .	5.12	9.41	14.53	85.47
2 years, . .	5 months, .	4.28	9.13	13.41	86.59
8 years, . .	9 months, .	3.31	8.85	12.16	87.84

Confectionery.

Several cases of alleged poisoning from eating confectionery have been brought to the notice of the Board during the year; and in each instance samples of confectionery of similar character to those which had been asserted as having produced poisonous symptoms, were obtained and submitted to chemical analysis. In no case, however, was any poisonous coloring matter, or other ingredient injurious to health, found to exist in the samples which were examined. The persons who had eaten the confectionery were children, and the reasonable explanation of the symptoms of illness which were observed was undoubtedly to be found in the quantity which they ate, and not in any actively poisonous ingredients contained in the confectionery.

Drugs.

The examination of drugs has been continued as in former years, and has been confined mainly to officinal preparations. The percentage of adulteration was less than that of any previous year; and this may be regarded as an actual and

not a merely apparent improvement. The articles selected for examination were mostly such as are peculiarly liable to adulteration.

The following lists comprise the articles which were found to be most seriously adulterated, and for which notices were issued to persons selling them. The names of the cities and towns where they were obtained are also given.

Drugs.

Adulterated Drugs for which Notices were sent.

Compound spirits of ether,	14	Red wine,	2
Sweet spirits of nitre,	5	Distilled water,	2
Laudanum,	5	Ethereal oil,	1
Solution citrate iron and quinine,	5	Tincture of nux vomica,	1
Solution citrate magnesia,	4	Spirits of nitrous ether,	1
Diluted hydrobromic acid,	3	Tannic acid,	1
Citrate iron and quinine,	2	Port wine,	1

Cities and Towns to which Notices were sent.

Athol,	2	Malden,	1
Boston,	22	Medford,	1
Cambridge,	3	New Bedford,	2
Chicopee Falls,	2	North Adams,	1
Clinton,	1	North Attleborough,	1
Danvers,	2	Pittsfield,	1
Fall River,	2	Waltham,	2
Gloucester,	1	Watertown,	2
Haverhill,	1		

Number of samples of drugs of standard quality,	465
Number of samples of drugs not of standard quality,	79
Total,	544

Prosecutions.

The number of complaints entered in the courts of the Commonwealth against offenders under the provisions of the food and drug acts was greater than that of any previous year. The following communication, which was sent to the Legislature early in the session of 1890, contains a statement of the prosecutions, and also of the expenses incurred in the execution of the law.

OFFICE OF THE STATE BOARD OF HEALTH,
13 BEACON STREET, February, 1890.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts, in General Court assembled.

In compliance with the provisions of chapter 289 of the Acts of 1884, the State Board of Health is required to "report annually to the Legislature the number of prosecutions made under said chapter, and an itemized account of all money expended in carrying out the provisions thereof."

The whole number of prosecutions made by authority of the Board, under the provisions of the food and drug acts, for the year ending Sept. 30, 1889, was 140.

The places where the articles were obtained, and in respect to the sale of which complaints were entered in court; the character of the articles found to be adulterated, or fraudulently sold; the dates of the trials and the result of the trials, — are given in the following table: —

MILK AND MILK PRODUCTS.

For Fraudulent Sales of Milk.

In Boston,	Oct. 12, 1888,	Convicted.
"	" 24, "	"
"	Dec. 17, "	"
"	Mar. 6, 1889,	"
"	May 22, "	"
"	" 23, "	Discharged.
"	" 29, "	Convicted.
"	June 3, "	"
"	July 13, "	"
"	Aug. 14, "	Discharged.
"	Sept. 20, "	Convicted.
Fall River,	Feb. 15, "	"
"	" 15, "	"
"	" 15, "	Discharged.
"	" 15, "	Convicted.
"	" 15, "	Discharged.
"	Mar. 7, "	Convicted.
"	" 14, "	Discharged.
"	" 19, "	Convicted.
"	" 21, "	Discharged.
"	" 7, "	Convicted.
"	" 7, "	"
"	April 20, "	Discharged.
Somerville,	Oct. 17, 1888,	Convicted.
Malden,	Nov. 10, "	"

In Quincy, ...	Nov. 13, 1888, .	Discharged.
"	Dec. 13, " .	Convicted.
"	May 31, 1889, .	"
Salem, ...	Jan. 26, " .	"
Waltham, . . .	Mar. 20, " .	"
" . . .	Sept. 27, " .	"
Cambridge, . . .	April 26, " .	"
" . . .	May 4, " .	"
Gloucester, . . .	" 10, " .	Discharged.
Haverhill, . . .	July 26, " .	Convicted.
Springfield, . . .	Sept. 13, " .	"
Deerfield, . . .	Oct. 22, 1888, .	"
Sherborn, . . .	" 10, " .	"
Lexington, . . .	Nov. 30, " .	"
Ashland, . . .	" 7, " .	"
" . . .	Feb. 23, 1889, .	"
Shrewsbury, . . .	Dec. 14, 1888, .	"
Pittsfield, . . .	Jan. 3, 1889, .	"
Dedham, . . .	" 25, " .	"
" . . .	Sept. 7, " .	"
" . . .	" 7, " .	"
Harvard, . . .	Feb. 11, " .	"
" . . .	June 19, " .	Case pending.
Winthrop, . . .	Mar. 5, " .	Convicted.
" . . .	" 13, " .	"
Holliston, . . .	" 22, " .	"
" . . .	Aug. 20, " .	"
" . . .	Sept. 25, " .	"
Westborough, . .	Mar. 27, " .	"
Chelmsford, . . .	April 18, " .	"
Dracut, ...	" 25, " .	"
"	" 25, " .	"
North Andover, . .	June 24, " .	"
Groton, ...	July 6, " .	"
Ayer, ...	" 6, " .	"
Littleton, . . .	" 6, " .	"
Revere, ...	Aug. 14, " .	"
Beverly, . . .	" 7, " .	Case pending.
Stoneham, . . .	" 10, " .	Convicted.
Hubbardston, . .	" 17, " .	"
" . . .	" 17, " .	"
	Total, 66 cases.	

For Fraudulent Sales of Adulterated Butter (Oleomargarine).

In New Bedford, . .	Dec. 14, 1888, .	Convicted.
" . .	" 28, " .	"
" . .	May 17, 1889, .	"
" . .	" 17, " .	"
" . .	" 17, " .	Discharged.

In Fall River, . . .	Dec. 28, 1888, .	Convicted.
"	" 28, " .	Discharged.
"	" 28, " .	Convicted.
"	May 9, 1889, .	"
Boston, ...	Aug. 6, " .	"
Lowell, ...	Oct. 23, 1888, .	"
"	" 31, " .	"
Lawrence, . . .	" 25, " .	"
"	" 25, " .	"
"	May 31, 1889, .	"
"	" 31, " .	"
Newburyport, . .	" 30, " .	"
Worcester, . . .	Nov. 15, 1888, .	"
"	" 15, " .	Discharged.
"	" 15, " .	Convicted.
"	" 15, " .	"
"	Dec. 22, " .	Discharged.
"	Feb. 27, 1889, .	"
Springfield, . . .	Nov. 17, 1888, .	Convicted.
"	Jan. 22, 1889, .	"
Holyoke, . . .	Nov. 17, 1888, .	"
"	" 17, " .	"
Lynn, ...	" 17, " .	"
"	" 30, " .	"
Taunton, . . .	" 30, " .	"
"	Dec. 13, " .	"
"	" 13, " .	Discharged.
"	" 13, " .	Convicted.
Haverhill, . . .	" 13, " .	"
"	Oct. 26, " .	"
"	May 24, 1889, .	"
Somerville, . . .	Dec. 20, 1888, .	"
Salem, . . .	Jan. 26, 1889, .	"
"	April 17, " .	"
Chelsea, . . .	Jan. 19, " .	"
Fitchburg, . . .	" 28, " .	"
Woburn, . . .	" 29, " .	"
Brockton, . . .	Feb. 23, " .	"
"	Mar. 2, " .	"
Marlborough, . .	Nov. 23, 1888, .	"
" . . .	April 27, 1889, .	"
" . . .	May 27, " .	"
North Adams, . .	Jan. 21, " .	"
Clinton, . . .	Mar. 8, " .	"
Webster, . . .	" 9, " .	"
Attleborough, . .	April 9, " .	"
Framingham, . .	May 27, " .	"
Brookline, . . .	Aug. 8, " .	"
	Total, 53 cases.	

OTHER ARTICLES OF FOOD.

Maple Syrup.

In Boston, ...	Mar. 29, 1889, .	Convicted.
"	May 28, " .	"
Medford, . . .	Feb. 5, " .	"
" . . .	April 11, " .	"
" . . .	" 26, " .	"
Attleborough, . .	" 9, " .	"

Maple Sugar.

In Boston, ...	Mar. 29, 1889, .	Convicted.
"	April 13, " .	"
"	May 9, " .	"
Lowell, ...	April 25, " .	"

Spices.

In Boston, ...	Oct. 6, 1888, .	(Pepper), Convicted.
Lowell, ...	Nov. 28, " .	(Pepper), "
"	" 28, " .	(Cloves), "
"	" 28, " .	(Cinnamon), "

Honey.

In Boston, ...	Oct. 16, 1888, .	Convicted.
Worcester, . . .	July 11, 1889, .	"

Molasses.

In Fall River, . . .	April 17, 1889, .	Convicted.
Boston, ...	June 29, " .	"
Lowell, ...	July 13, " .	"

Lemon Juice.

In Boston, ...	May 28, 1889, .	Convicted.

Cream of Tartar.

In Boston, ...	Oct. 6, 1888, .	Convicted.

Milk, ...	66 cases.
Butter, ...	53 "
Other articles of food, ...	21 "
Total, ...	140 "

SUMMARY.

The whole number of complaints entered by the State Board of Health against parties for violation of the food and drug acts was 140; of which 124, or 88.5 per cent., resulted in conviction, 13 were discharged, and 3 cases are still pending in the superior courts.

Of these cases, 66 were for violation of the milk laws; of which 56 of the parties were convicted, 8 were discharged, and 2 are still pending.

There were 53 complaints entered under the oleomargarine laws; of which 47 resulted in conviction, 5 were discharged, and 1 is still pending.

For violation of the laws relative to other articles of food there were 21 complaints, all of which resulted in conviction.

In 18 cases entered under the milk laws appeals were taken, and in 24 cases under the oleomargarine laws. In nearly all of the appealed cases the fines were paid either very soon after the appeals were taken or in the upper court.

In two cases only, and these under the milk laws, were the decisions of the lower courts reversed by the superior court.

Special Cases Requiring Comment.

In one of the cases in which the decision of the lower court was reversed by a jury, it was shown that the sample required by the statute to be given to the defendant was taken from the milk-can out of which he was delivering milk, instead of being taken from the sample upon which the complaint was made. In the other case the complaint alleged that water had been added to the milk, but it could not be proven that the defendant added the water. Nearly all of the cases entered under the milk laws were for sales of milk not of standard quality. The samples of milk upon which complaints were founded ranged from 5.46 to 11.86 per cent. of total solids. (The standard required by the statute for whole milk is 13 per cent., except in May and June, when it is 12 per cent.)

The complaints under the oleomargarine laws were entered for the following offences: —

For selling oleomargarine in a tub not labelled upon the top, side and bottom.

For exposing for sale not in the original package, and not labelled "Oleomargarine."

For sale at retail, the outside of wrapper not being labelled "Oleomargarine."

For sale at retail, the outside of the wrapper not being plainly labelled "Oleomargarine."

For selling oleomargarine in a tub labelled "Dairy."

For selling oleomargarine without being registered.

For selling oleomargarine as pure butter.

Fines.

The amount of the fines paid to the treasuries of counties, cities and towns, under the provisions of the general and special laws relative to food and drug inspection, was as follows: —

Fines paid for Violation of the Food and Drug Acts, upon Cases entered for the Year ending Sept 30, 1889.

Under the provisions of the milk laws, ...	$1,675 00
Under the provisions of oleomargarine or butter laws, . .	1,850 00
Under the provisions of laws relative to other articles of food,	364 00
Total, ...	$3,889 00

Expenditures.

Expenses of Food and Drug Inspection from Oct. 1, 1888, to Sept. 30, 1889, under the Provisions of Chapters 263 of the Acts of 1882, and 289 of the Acts of 1884, relative to Food and Drug Inspection.

	Milk and Milk Products.	*Other Articles of Food and Drugs.*
Salaries of analysts, .	$3,076 68	$1,590 01
Salaries of inspectors, .	2,116 67	880 00
Travelling expenses and purchase of samples, .	1,318 32	878 88
Legal services, . .	236 16	157 44
Special analyses, . .	–	33 00
Bottles, corks, twine and incidentals, . . .	51 72	–
Printing, ...	10 44	6 96
	$6,809 99	$3,546 29
		6,809 99
	Total, . . .	$10,356 28

SAM'L W. ABBOTT, *Secretary.*

REPORTS OF THE ANALYSTS.

DR. HARRINGTON'S REPORT UPON FOOD.

REPORTS OF THE ANALYSTS.

DR. HARRINGTON'S REPORT UPON FOOD.

Boston, Mass., Oct. 1, 1889.

Dr. Samuel W. Abbott, *Secretary of the State Board of Health.*

Dear Sir: — I have the honor to submit the following report on the examination of samples of food other than milk, for the year ending Sept. 30, 1889.

During the past twelve months I have received and examined 1,470 samples, mostly of those foods which experience has shown to be specially liable to adulteration. Of this number, there were 306 (or 20.8 per cent.) which proved to be adulterated. The adulterations, with few exceptions, were of a purely fraudulent character, and not injurious to health. Two samples contained accidental contaminations of a dangerous character, and the more dangerous because of the insidious and cumulative action of the impurity. These samples were of lemonade and "sarsaparilla," contained in bottles provided with patent stoppers composed of metallic lead, which, being in constant contact with the acid liquids, was readily acted upon by the latter, which were thereby converted from harmless drinks into subtle poisons.

Seven samples of molasses were contaminated with poisonous salts of tin, added for the purpose of improving the color, and to produce a fictitious value.

The only other substance detected which can be regarded as deleterious to health is one concerning the effects of which on the human system there is considerable difference of opinion. This substance is alum, which is a very common ingredient of the cheaper and cheapest kinds of baking

powders. Its injuriousness not being as yet satisfactorily proven, it may not fairly be classed with those substances whose deleterious character is beyond question.

Of the detected adulterations, as a whole, it may be said that they are of the same general nature as in years past.

The following samples were received and examined : —

Butter, 58. All but four of these were pure butter of various grades. The exceptions proved to be oleomargarine, although there was nothing on the wrappers to indicate their character.

Cheese, 22. All genuine.

Lard, 8. Five of these contained beef fat, or cotton-seed oil, or both. Recent advances in the methods of examination of lard have rendered it possible to determine the true nature of any sample with great certainty, whereas but a short time ago the element of conjecture was more or less prominent.

Olive oil, 25. Thirteen genuine ; twelve were cotton-seed oil. Many of the older spurious brands are now sold not as "olive oil," but as "salad oil," which latter term may include any vegetable oil which may be used in the same manner and for the same purposes as olive oil. The twelve adulterated samples included the following brands : —

E. Loubon, Nice.
Huile d'Olive, Nice.
F. Cartoux, Nice.
S. Larcher, Jeune, Bordeaux.
Ducro & Cie.
Guillaume.
A. Seguin, Huile d'Olive Vierge.

Cider vinegar, 90. Thirty-five were above the standard, both as to acidity and residue. Fifty-five were deficient in one or the other or in both, but most frequently in residue alone.

Lemon juice, 8. All adulterated. It may safely be asserted that such a thing as genuine bottled lemon juice does not exist in the market. The United States Dispen-

satory says that, "from its liability to spontaneous decomposition, it speedily becomes unfit for medical use; and, though various means have been resorted to for its preservation, it can never be made to retain for any length of time its original flavor unaltered." The United States Pharmacopœia describes this product as follows: "A slightly turbid yellowish liquid, odorless, or having an odor of lemon due to the accidental presence of the volatile oil of the rind, and an acid taste and reaction. Specific gravity not less than 1.030. On evaporating a portion of the juice to dryness, and igniting the residue, not more than 0.5 per cent. of ash should remain. Fresh lemon juice contains about 7 per cent. of citric acid." The eight samples examined proved to be nothing more than simple solutions of the acid in water, with, in some cases, a flavoring of oil of lemon. Following are the figures obtained on examination: —

Inspector's Number.	Specific Gravity.	Acidity.	Ash.	Brand.
3836 C,	1.021	4.26	0.03	F. P. Adams & Co., Boston.
3838 C,	1.021	4.26	0.03	F. P. Adams & Co., Boston.
3912 C,	1.022	4.22	0.00	H. H. Wetherbee & Co., Boston.
4936 C,	1.020	4.29	0.00	F. P. Adams & Co , Boston.
5012 C,	1.025	6.08	0.00	Houghton & Dutton, Boston.
5456 C,	–	5.25	–	– – –
7517 C,	1.020	4.86	0.01	H. H. Wetherbee & Co., Boston.
7535 C,	1.022	4.17	0.04	F. P. Adams & Co., Boston.

Honey, 54. Nineteen of these samples proved to be mixtures containing varying proportions of glucose syrup. The following brands were represented among the adulterated samples: —

Austin Nichols & Co., New York.
W. J. Lamb, Medford, Mass.
Samuel J. Geer, Medford, Mass.
David H. Geer, South Boston.
Hildreth Bros. & Segelken.
H. D. Gloyd.
Mohawk Valley, — particularly for medical use.
Pure Orange-blossom Honey, F. G. Strohmeyer, N. Y.
A. J. Raymond, Everett, Mass.

Seven adulterated samples bore no labels.

Molasses, 197. Twenty-five samples contained added glucose, and seven contained salts of tin. It is but fair to state that the latter were taken from the original packages at the place of reception. Much of the molasses which is found in the market adulterated with glucose is bought by our dealers in good faith from wholesale dealers in New York.

Maple sugar, 31. Eight of these samples consisted wholly or in part of molasses sugar; several of these had absolutely no flavor of the genuine article.

Maple syrup, 55. Of these samples, the larger proportion (37) were adulterated with glucose or brown sugar. The following brands were represented: —

Lord & Carlyle.
W. J. Lamb, Medford.
F. P. Adams & Co., Boston.
A. J. Raymond, Everett.
Curtice Bros., Dorchester, N. Y.
Samuel J. Geer, Medford.
David H. Geer, South Boston.
H. D. Gloyd.
Boyd's Green Mountain.
Greensborough, Vt.
Woodstock, Vt.
Wilmington, Vt.
Rochester, Vt.
Orange County, Vt.

Candy, 21. Nearly all of these samples were bright colored. In no case was any harmful coloring matter detected. Although many of them contained glucose and flour, they must all be regarded as genuine, as there is no standard for candies except that they must contain nothing deleterious.

Tea, 39. All genuine, though many appeared to be of the cheapest grades.

Coffee, 18. All genuine.

Cocoa, 6. Two of these samples were adulterated with wheat flour.

Baking powders, 20. Eighteen of these were made with alum, concerning the wholesomeness of which opinion is divided. Brands known to be free from alum were not purchased. The following brands contained alum: —

Hygienic.	Baloon.
Puritan.	London.
Crystal.	Dry Yeast.
Ideal.	One Spoon.
Oriole.	Silver Star.
Liberty.	Grand Union Tea Company.
Davis.	G. A. & P. Tea Company.
Cottage.	Crown.

Cream of tartar, 189. Nineteen proved to be adulterated. One consisted wholly of acid phosphate and corn starch, one of alum and corn starch; and others contained varying amounts of cream of tartar, with rice flour, corn starch, sulphate of calcium and other inert substances. The proportion of the genuine article in these latter ranged from 18 to 89 per cent.

Soda, 19. All of good quality.

Black pepper, 103. Twenty-eight contained added foreign substances of the usual character, — ground cracker, corn, pepper dust, buckwheat, rice, Mallaguetta pepper, etc. Most of the adulterated samples were purchased in bulk; eight were labelled as follows: —

(5) E. W. Ropes, 185 Chambers Street, New York.
(1) Hope Mills, Providence, R. I.
(1) W. H. Gilbert & Co.
(1) Allyn & Blanchard, Hartford, Conn.

White pepper, 65. Eleven adulterated. Among the latter the following brands appeared: —

Narragansett Mills, Providence, R. I.
Hope Mills, Providence, R. I.

Allspice, 25. Four adulterated. These were labelled: —

(3) E. W. Ropes, 185 Chambers Street, New York.
(1) Hope Mills, Providence, R. I.

Mace, 14. Two adulterated; one with wheat, the other with wheat and corn.

Cayenne, 21. Five adulterated. The only one of the latter not bought in bulk was labelled : —

E. W. Ropes, 185 Chambers Street, New York.

Cassia, 138. Nine adulterated. One of the latter was marked "Pure Compound," the idea of the manufacturer evidently being that this misleading expression would act as a bar to prosecution under the clause of the statute wherein compounds with foreign substances are exempted from the provisions of the law when so marked. Three of the adulterated samples were marked with the names of the manufacturers, as follows : —

Crescent Mills, New Haven, Conn.
Massasoit Mills.
G. K. Birdsey, Bridgeport, Conn.

Mustard, 61. Twenty were adulterated with rice flour or wheat flour, and turmeric. The following brands were found to be adulterated : —

Cole & Firth.
Durham.
Colman's.
Colburn's.
Boston Mills.

Ginger, 76. Five adulterated; three contained wheat, one corn, and one turmeric. Two of the five were labelled :

E. W. Ropes, 185 Chambers Street, New York.

Cloves, 73. Eighteen adulterated. Among the latter the following brands were represented : —

Narragansett Mills.
Lester's, Providence, R. I.
Crescent Mills, New Haven.

Miscellaneous. The following articles, some of which are proprietary preparations, for which there can be no standard of purity beyond the absence of deleterious substances, were examined and passed as genuine : —

Cocoatheta, celery salt, gelatin, savory, canned pease, white oats, desiccated cocoanut, bread, and cake, one each. Nutmeg, and currie, two each. Flavoring extracts, horseradish, fruit puddine, and cider jelly, three each. Sugar, six.

A sample of currant jelly proved to be cider jelly, colored with an aniline. Two samples of non-alcoholic beverages — lemonade and "sarsaparilla" — were found to be very seriously contaminated with lead from the stoppers of the bottles in which they were contained. At least one case of chronic lead-poisoning is known to have occurred from continued use of these drinks.

Respectfully,

CHARLES HARRINGTON, M.D.

DR. WORCESTER'S REPORT UPON MILK.

BOSTON, Oct. 1, 1889.

Dr. S. W. ABBOTT, *Secretary of the State Board of Health.*

DEAR SIR: — I have the honor to submit the following report on the examination of milk for the year ending Sept. 30, 1889. During the year, 1,658 samples were received. Of these, 1,095 were from 17 cities of the State, 306 from 17 towns, 148 were taken from suspected producers, and 109 were samples of known purity. Of the whole number, 906, or 54.6 per cent., proved to be of standard quality; and 752, or 45.4 per cent., fell below the standard.

Inspection of Seventeen Cities' Supply.

CITIES.	Number of Samples Taken.	Number of Samples below Standard.	Per Cent. of Number below Standard.	Per Cent. of Number containing less than 12 Per Cent. Solids.
Brockton,	36	7	19	5
Gloucester,	47	14	29	16
Lawrence,	56	20	35	14
Chelsea,	67	26	38	15
Lowell,	96	37	39	15
Boston,	38	15	39	2
Salem,	45	18	40	13
Haverhill,	66	27	40	10
Malden,	34	14	41	20
Newburyport,	35	15	42	0
Waltham,	37	17	45	11
Lynn,	89	41	46	17
Newton,	78	39	50	9
Fall River,	62	32	51	8
Cambridge,	208	122	58	16
Worcester,	26	17	65	23
Somerville,	55	36	65	26
Totals,	1,095	497	45	13

This number includes six skimmed milks of standard quality.

Inspection of Seventeen Towns' Supply.

TOWNS.	Number of Samples Taken.	Number of Samples below Standard.	Per Cent. of Number below Standard.	Per Cent. of Number containing less than 12 Per Cent. Solids.
Stoneham,	12	0	0	0
Amesbury,	9	0	0	0
Nantucket,	10	1	10	0
Marlborough,	24	5	20	0
Plymouth,	23	6	26	17
South Framingham,	27	8	29	15
Watertown,	13	4	30	30
Beverly,	12	4	33	0
Woburn,	20	7	35	10
Quincy,	11	4	36	0
Medford,	8	3	37	0
Melrose,	10	4	40	10
Natick,	56	23	41	8
Provincetown,	12	5	41	33
Danvers,	8	4	50	16
Swampscott,	10	6	60	10
Winchester,	12	9	75	41
Totals,	306	93	30	9

This number includes six samples of skimmed milk of standard quality. Owing to the fewness of samples taken from several of these towns, it is probable that the average of purity found is not in all cases a fair one.

From Suspected Producers.

One hundred and forty-eight samples were taken from farmers of whom some complaint had been heard. These were from the towns of Andover, Ashland, Ayer, Carlisle, Chelmsford, Dracut, Fayville, Groton, Harvard, Holliston, Hopkinton, Hubbardston, Lexington, Lincoln, Littleton, West Medway, Somerset, Wenham, Westborough and Weston.

Of these samples, 6 contained between 14 and 15 per cent. total solids; 39 contained between 13 and 14 per cent. total solids; 52 contained between 12 and 13 per cent. total solids; 43 contained between 11 and 12 per cent. total solids; 18 contained between 10 and 11 per cent. total solids; 14

contained between 9 and 10 per cent. total solids ; 12 contained between 8 and 9 per cent. total solids ; 3 contained between 7 and 8 per cent. total solids ; 1 contained between 6 and 7 per cent. total solids.

Total : 51 of standard quality, 97 below standard, 66 per cent. below standard, and 34 per cent. containing less than 12 per cent. solids.

Samples of Known Purity.

Of 115 samples of known purity, 5 contained over 15 per cent. total solids ; 10 contained between 14 and 15 per cent. total solids ; 33 contained between 13 and 14 per cent. total solids ; 46 contained between 12 and 13 per cent. total solids ; 19 contained between 11 and 12 per cent. total solids ; 2 contained between 10 and 11 per cent. total solids.

Total : 48 of standard quality, 67 below standard, 58 per cent. below 13 per cent. total solids, 18 per cent. below 12 per cent. total solids.

These analyses in detail are as follows : —

Analyses.

Time of Year.	Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Per Cent. Fat.	Per Cent. Solids not Fat.	Total Solids.	Ash.	Dairy Av'ges. Total Solids.
1889.										
Sept. 16, P.M.,	Westborough,	7 years,	8 months,	Durham and Ayrshire,	Corn fodder and 4 quarts of grain,	4.04	9.83	13.87	.73	
" "	"	7 years,	5 months,	Durham and Ayrshire,	Corn fodder and 4 quarts of grain,	3.08	8.98	12.06	.69	12.72
" "	"	3½ years,	2 months,	Durham and Ayrshire,	Corn fodder and 4 quarts of grain,	3.16	9.08	12.24	.63	
" "	"	4 years,	2 weeks,	Durham and Jersey,	Sweet corn, 3 quarts meal and shorts,	2.55	9.25	11.80	.70	
" "	"	6 years,	8 months,	Holstein and Jersey,	Sweet corn, 3 quarts meal and shorts,	4.02	9.12	13.14	.80	
" "	"	9 years,	3 months,	Durham and Jersey,	Sweet corn, 3 quarts meal and shorts,	3.37	9.50	12.87	.67	12.72
" "	"	4 years,	5 months,	Durham,	Sweet corn, 3 quarts meal and shorts,	3.41	9.66	13.07	.65	
" "	"	7 years,	5 months,	Short Horn,	Corn fodder, corn and bran,	3.09	9.14	12.23	.61	12.73
" "	"	10 years,	5 months,	Grade Jersey,	Corn fodder, corn and bran,	3.50	9.74	13.24	.60	
" "	"	2½ years,	4 months,	Grade Holstein,	Corn fodder and grain,	3.82	9.69	13.51	.67	
" "	"	7 years,	10 months,	Grade Holstein,	Corn fodder and grain,	2.84	8.84	11.68	.78	
" "	"	6 years,	3 weeks,	Grade Durham,	Corn fodder and grain,	3.41	8.76	12.17	.82	
" "	"	10 years,	1 year,	Grade Holstein,	Corn fodder and grain,	1.95	8.78	10.73	.59	11.88
" "	"	9 years,	2 months,	Grade Holstein,	Corn fodder and grain,	2.45	8.79	11.24	.61	
" "	"	10 years,	9 months,	Grade Holstein,	Corn fodder and grain,	3.34	8.59	11.93	.57	

Analyses — Continued.

Time of Year.	Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Per Cent. Fat.	Per Cent. Solids not Fat.	Total Solids.	Ash.	Dairy Av'ges. Total Solids.
1889.										
Sept. 17, P.M.,	Westborough,	5 years,	18 months,	Holstein and Durham,	Middlings, etc.,	2.99	9.59	12.58	.63	
" "	"	7 years,	1 week,	Holstein,	Middlings, etc.,	2.71	9.18	11.89	.61	
" "	"	5 years,	6 weeks,	Ayrshire and Holstein,	Middlings, etc.,	2.50	8.86	11.36	.57	11.76
" "	"	2 years,	6 months,	Ayrshire and Holstein,	Middlings, etc.,	2.22	9.67	11.89	.61	
" "	"	2 years,	6 months,	Three-quarters Holstein,	Middlings, etc.,	2.01	9.07	11.08	.58	
" "	"	7 years,	5 weeks,	Holstein,	Two quarts shorts, 2 quarts cornmeal, 2 quarts linseed meal, and corn fodder,	3.20	9.23	12.43	.63	
" "	"	2 years,	5 months,	Grade Holstein,	Two quarts shorts, 2 quarts cornmeal, 2 quarts linseed meal, and corn fodder,	1.97	10.00	11.97	.60	
" "	"	4 years,	1 year,	Grade Holstein,	Two quarts shorts, 2 quarts cornmeal, 2 quarts linseed meal, and corn fodder,	2.43	9.81	12.24	.58	12.30
" "	"	4 years,	7 weeks,	Holstein,	Two quarts shorts, 2 quarts cornmeal, 2 quarts linseed meal, and corn fodder,	1.92	10.12	12.04	.79	
" "	"	5 years,	3½ weeks,	Grade Holstein,	Two quarts shorts, 2 quarts cornmeal, 2 quarts linseed meal, and corn fodder,	2.74	10.09	12.83	.62	
" "	"	4 years,	5 months,	Jersey,	Pumpkins and corn fodder, 1 quart meal, 1 quart shorts,	5.97	9.62	15.59	.60	
" "	"	7 years,	10 months,	Holstein,	Corn fodder, bran, cornmeal, linseed meal,	2.49	8.37	10.86	.58	
" "	"	4 years,	5 months,	Grade Holstein,	Corn fodder, bran, cornmeal, linseed meal,	2.86	8.39	11.25	.56	
" "	"	4 years,	4 months,	Holstein,	Corn fodder, bran, cornmeal, linseed meal,	2.88	8.72	11.60	.59	12.97
" "	"	3 years,	5 months,	Holstein,	Corn fodder, bran, cornmeal, linseed meal,	3.93	9.32	13.25	.69	
" "	"	4 years,	8 months,	Holstein,	Corn fodder, bran, cornmeal, linseed meal,	3.46	9.46	12.92	.64	

Sept. 20, P.M.,	North Grafton, .	6 years,	18 months,	Grade Holstein, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	4.71	9.54	14.25	.73	
" "	" .	5 years,	3 months,	Grade Holstein, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.23	9.22	12.45	.60	
" "	" .	4 years,	3 months,	Ayrshire, ...	Corn fodder, 4 quarts meal, and brewers' grains, ...	2.76	9.44	12.20	.62	
" "	" .	5 years,	9 months,	Grade Durham, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.32	9.23	12.55	.64	
" "	" .	4 years,	18 months,	Grade Ayrshire, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.38	10.68	14.06	.73	
" "	" .	9 years,	2 months,	Grade Holstein, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	2.61	9.39	12.00	.65	
" "	" .	4 years,	9 months,	Ayrshire, ...	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.10	8.90	12.00	.60	12.71
" "	" .	4 years,	6 months,	Grade Ayrshire, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.22	9.62	12.84	.64	
" "	" .	4 years,	15 months,	Grade Ayrshire, . .	Corn fodder, 4 quarts meal, and brewers' grains, ...	3.05	9.69	12.74	.64	
" "	" .	4 years,	6 months,	Grade Ayrshire, . .	Corn fodder, meal and brewers' grains,	3.57	9.03	12.60	.54	
" "	" .	4 years,	4 months,	Grade Ayrshire, . .	Corn fodder, meal and brewers' grains,	2.78	9.74	12.52	.64	
" "	" .	8 years,	13 months,	Ayrshire, ...	Corn fodder, meal and brewers' grains,	3.65	8.74	12.39	.57	
Sept. 25, P.M.,	Westborough, .	8 years,	7 months,	Grade Ayrshire, . .	Two quarts cornmeal and 2 quarts gluten meal, ...	3.30	9.43	12.73	.62	
" "	" .	6 years,	2 years, .	Grade Ayrshire, . .	Two quarts cornmeal and 2 quarts gluten meal, ...	3.87	10.10	13.97	.59	
" "	" .	6 years,	2 weeks, .	Grade Ayrshire, . .	Two quarts cornmeal and 2 quarts gluten meal, ...	3.90	9.45	13.35	.63	13.32
" "	" .	8 years,	1 year, .	Grade Ayrshire, . .	Two quarts cornmeal and 2 quarts gluten meal, ...	3.88	9.37	13.25	.63	
" "	" .	9 years,	3 weeks, .	Grade Ayrshire, . .	Four quarts shorts and corn fodder, .	4.02	9.21	13.23	.65	
" "	" .	5 years,	5 months,	Grade Ayrshire, . .	Four quarts shorts and corn fodder, .	2.94	9.66	12.60	.61	13.09
" "	" .	6 years,	3 weeks, .	Grade Durham, . .	Four quarts shorts and corn fodder, .	3.70	9.23	12.93	.62	
" "	" .	3 years,	5 weeks, .	Grade Jersey, . . .	Four quarts shorts and corn fodder, .	3.94	9.69	13.63	.61	

Analyses — Continued.

Time of Year.	Where obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Per Cent. Fat.	Per Cent. Solids not Fat.	Total Solids.	Ash.	Dairy Av'ges. Total Solids.
1889.										
Sept. 25, P.M.,	Westborough, .	6 years,	4 months,	Grade Ayrshire, . .	Cotton-seed meal, middlings and corn fodder, ...	2.99	10.25	13.24	.62	
" "	" .	3 years,	3 months,	Grade Ayrshire, . .	Cotton-seed meal, middlings and corn fodder, ...	3.25	10.05	13.30	.62	
" "	" .	3 years,	3 months,	Grade Holstein, . .	Cotton-seed meal, middlings and corn fodder, ...	3.38	9.23	12.61	.60	12.92
" "	" .	5 years,	3 months,	Grade Ayrshire, . .	Cotton-seed meal, middlings and corn fodder, ...	3.13	9.64	12.77	.58	
" "	" .	4 years,	2½ months,	Grade Ayrshire, . .	Cotton-seed meal, middlings and corn fodder, ...	3.22	9.47	12.69	.60	
" "	" .	10 years,	17 months,	Grade Ayrshire, . .	Six quarts meal and 2 quarts middlings,	2.72	9.11	11.83	.62	
" "	" .	8 years,	6 months,	Grade Ayrshire, . .	Six quarts meal and 2 quarts middlings,	2.29	10.24	12.53	.67	12.83
" "	" .	3 years,	7 months,	Grade Jersey, . . .	Six quarts meal and 2 quarts middlings,	3.58	10.55	14.13	.68	
Sept. 26, P.M.,	" .	5 years,	1 week, .	Grade Ayrshire, . .	Two quarts shorts, 2 quarts gluten meal, and corn fodder, . . .	2.31	9.29	11.60	.67	
" "	" .	7 years,	4 months,	Grade Jersey, . . .	Two quarts shorts, 2 quarts gluten meal, and corn fodder, . . .	6.46	10.27	16.73	.67	14.07
" "	" .	Unknown,	6 months,	Native, ...	Two quarts shorts, 2 quarts gluten meal, and corn fodder, . . .	3.32	10.58	13.90	.64	
" "	" .	7 years,	2 months,	Grade Ayrshire, . .	Two quarts corn meal, 2 quarts gluten meal, 2 quarts shorts and corn fodder,	4.02	8.91	12.93	.51	
" "	" .	6 years,	4 months,	Ayrshire and Jersey, .	Two quarts corn meal, 2 quarts gluten meal, 2 quarts shorts and corn fodder,	3.55	9.38	12.93	.52	
" "	" .	5 years,	3 months,	Grade Holstein, . .	One quart corn meal, 1 pint gluten meal and 2 quarts shorts, . . .	2.50	9.05	11.55	.47	12.57
" "	" .	9 years,	7 months,	Ayrshire and Holstein, .	One quart corn meal, 1 quart shorts and corn fodder, ...	3.82	9.63	13.45	.74	
" "	" .	3 years,	5 months,	Three-quarters Holstein,	One quart corn meal, 1 quart shorts and corn fodder, ...	3.12	8.89	12.01	.61	

" "	"	12 years,	6 weeks,	Grade Ayrshire,	One quart linseed meal, 6 quarts shorts and corn fodder,	3.47	10.36	13.83	.64	
" "	"	5 years,	Unknown,	Native,	One quart linseed meal, 6 quarts shorts and corn fodder,	2.64	8.85	11.49	.45	
" "	"	9 years,	5 months,	Grade Guernsey,	One quart linseed meal, 6 quarts shorts and corn fodder,	4.93	10.14	15.07	.67	13.51
" "	"	12 years,	4 months,	Grade Ayrshire,	Meal, shorts, linseed meal and corn fodder,	4.58	9.38	13.96	.50	
" "	"	8 years,	Unknown,	Ayrshire and Durham,	Meal, shorts, linseed meal and corn fodder,	3.90	9.30	13.20	.59	
" "	"	5 years,	1 month,	Durham,	Corn fodder, etc.,	2.88	9.01	11.89	.60	
" "	"	3 years,	1 week,	Ayrshire and Durham,	Corn fodder, etc.,	3.01	9.74	12.75	.63	12.30
" "	"	10 years,	7 weeks,	Ayrshire,	Corn fodder, etc.,	2.47	9.80	12.27	.62	
Sept. 27, P.M.,	"	9 years,	5 months,	Grade Ayrshire,	Six quarts corn meal, oats and corn fodder,	3.69	9.58	13.27	.60	
" "	"	9 years,	10 months,	Native,	Six quarts corn meal, oats and corn fodder,	5.18	9.93	15.11	.61	
" "	"	2 years,	5 months,	Grade Ayrshire,	Six quarts corn meal, oats and corn fodder,	2.98	9.11	12.09	.60	
" "	"	8 years,	5 months,	Grade Ayrshire,	Six quarts corn meal, oats and corn fodder,	3.39	9.26	12.65	.51	13.12
" "	"	11 years,	5 months,	Native,	Six quarts corn meal, oats and corn fodder,	3.90	9.72	13.62	.64	
" "	"	10 years,	5 months,	Native,	Six quarts corn meal, oats and corn fodder,	3.47	8.53	12.00	.56	
" "	"	7 years,	1 week,	Grade Ayrshire,	Six quarts shorts, middlings and corn meal,	2.94	10.28	13.22	.57	
" "	"	6 years,	6 weeks,	Holstein and Durham,	Six quarts shorts, middlings and corn meal,	3.05	8.78	11.83	.51	
" "	"	7 years,	8 months,	Ayrshire and Durham,	Six quarts shorts, middlings and corn meal,	2.97	9.29	12.26	.52	
" "	"	7 years,	6 months,	Grade Ayrshire,	Six quarts shorts, middlings and corn meal,	3.25	9.58	12.83	.55	12,54
" "	"	3 years,	6 months,	Grade Holstein,	Six quarts shorts, middlings and meal,	2.53	9.40	11.93	.52	
" "	"	2 years,	6 months,	Ayrshire and Holstein,	Six quarts shorts, middlings and meal,	3.27	9.91	13.18	.56	

Analyses — Concluded.

Time of Year.	Where Obtained.	Age of Cow.	Time since Calving.	Breed.	Character of Feed.	Per Cent. Fat.	Per Cent. Solids not Fat.	Total Solids.	Ash.	Dairy Av'ges. Total Solids.
1889.										
Sept. 27, P.M.,	Westborough, .	7 years,	18 months,	Jersey, ...	Two quarts shorts, 2 quarts meal, corn fodder and pumpkins, . . .	3.67	9.67	13.34	.58	
" "	" .	2 years,	6 months,	Grade Holstein, . .	Two quarts shorts, 2 quarts meal, corn fodder and pumpkins, . . .	2.24	9.38	11.62	.55	
" "	" .	2½ years,	5 months,	Jersey, ...	Two quarts shorts, 2 quarts meal, corn fodder and pumpkins, . . .	3.22	9.92	13.14	.60	12.75
" "	" .	6 years,	6 months,	Ayrshire and Durham, .	Two quarts shorts, 2 quarts meal, corn fodder and pumpkins, . . .	3.10	9.80	12.90	.51	
Oct. 2, P.M.,	" .	8 years,	5 months,	Grade Ayrshire, . .	Field feed, ...	3.21	9.79	13.00	.70	
" "	" .	10 years,	1 month,	Grade Ayrshire, . .	Two quarts meal, 2 quarts middlings, .	3.97	9.50	13.47	.58	
" "	" .	5 years,	4 months,	Three-quarters Holstein,	Field feed, ...	3.14	9.07	12.21	.67	
" "	" .	12 years,	5 months,	Durham, ...	Field feed, ...	3.29	9.66	12.95	.54	
" "	" .	5 years,	5 months,	Durham, ...	Field feed, ...	4.59	10,00	14.59	.59	
" "	" .	10 years,	10 months,	Three-quarters Holstein,	Two quarts middlings and shorts, .	2.96	9.67	12.63	.59	
" "	" .	5 years,	4 months,	Grade Jersey, . . .	Two quarts middlings and shorts, .	4.69	9.55	14.24	.60	
" "	" .	3½ years,	6 months,	Grade Jersey, . . .	Three quarts shorts, ...	3.95	9.94	13.89	.65	
" "	" .	8 years,	13 months,	Grade Jersey, . . .	Four quarts shorts and 2 quarts cotton-seed meal, ...	3.14	10.11	13.25	.70	
" "	" .	3 years,	1 week, .	Three-quarters Ayrshire,	Four quarts shorts and 2 quarts cotton-seed meal, ...	3.28	9.18	12.46	.63	
" "	" .	12 years,	9 months,	Three-quarters Ayrshire,	Four quarts shorts and 2 quarts cotton-seed meal, ...	3.46	9.14	12.60	.60	
" "	" .	4 years,	9 months,	Three-quarters Holstein,	Four quarts shorts and 2 quarts cotton-seed meal, ...	3.25	9.80	13.05	.61	

Oct. 3, P.M.,	Beverly Farms,	3 years,	13 days,	Jersey,	Two quarts shorts, 1 quart corn meal, and grass,	2.88	9.58	12.46	.67	13.40
" "	"	4⅔ years,	7 days,	Mixed,	Two quarts shorts, 1 quart corn meal, and grass,	3.01	11.13	14.14	.79	
" "	"	6 years,	8 months,	Mixed,	Two quarts shorts, 1 quart corn meal, and grass,	3.81	9.35	13.16	.59	
" "	"	5 years,	8 months,	Mixed,	Two quarts shorts, 1 quart corn meal, and grass,	3.91	9.99	13.90	.62	
" "	"	10 years,	5 months,	Mixed,	Two quarts shorts, 1 quart corn meal, and grass,	4.64	10.03	14.67	.67	
" "	"	11 years,	6 months,	Jersey,	Two quarts shorts, 1 quart corn meal, and grass,	2.81	9.28	12.09	.54	

Summary.

Of these samples of known purity, 5 contained over 15 per cent. of total solids; 8 contained between 14 and 15 per cent. of total solids; 31 contained between 13 and 14 per cent. of total solids; 44 contained between 12 and 13 per cent. of total solids; 19 contained between 11 and 12 per cent. of total solids, 2 contained between 10 and 11 per cent. of total solids.

Respectfully submitted,

CHARLES P. WORCESTER.

DR. DAVENPORT'S REPORT.

FOOD.

BOSTON, Oct. 1, 1889.

S. W. ABBOTT, M.D., *Secretary State Board of Health.*

SIR: — I have the following report to make upon the 165 samples of food which were submitted to me for examination during the past twelve months. Of these, 87, or 52.72 per cent., were found not to be of their proper standard quality, as required by the provisions of the food and drug acts. This large percentage is to be considered in connection with the fact that a large proportion of the articles were purchased with a very strong suspicion that they would not upon examination prove to be genuine.

Among the samples were 107 of so-called butter, of which 71 proved upon examination to be oleomargarine. All of these last had been judged by the collector to be oleomargarine, and were therefore purchased. It seems that oleomargarine can usually be readily detected by the absence of the full butter flavor of the genuine article. Of 41 samples of maple syrups, 15 were found more or less large admixtures of glucose syrup. There were also examined 2 samples of lard, 1 of cheese, 1 of cider, 1 of flavoring essence, 1 of beer, 1 of meal, 2 of molasses, 2 of cream of tartar, 2 of honey, 4 of tea and 1 of candy, and they were all found to be of good standard quality.

Thus, fortunately, by the above 165 samples at least, however much the public would be commercially defrauded by their unrestricted sale, yet no one would have been at all injured in health. As the United States Commissioner of Internal Revenue says, in his late report, "Food adulteration is carried on by manufacturers in the interest of pecu-

niary profit and gain, and they take pains to keep themselves well posted on the subject of cheap and harmless substitutes." This, fortunately, has usually been found to be true concerning the food adulteration of late years detected in this State.

Respectfully submitted,

BENNETT F. DAVENPORT.

DR. DAVENPORT'S REPORT.

MILK.

Boston, Oct. 1, 1889.

S. W. Abbott, M.D., *Secretary State Board of Health.*

Sir : — I have the following report to make upon the 1,261 samples of milk which have been submitted to me for examination during the past twelve months. Of these, 818, or 64.86 per cent., were found to be of the "good standard quality," of not less than 13 per cent. of total milk solids, required by the statute relating to milk; while 88 per cent. of all samples had not less than 12 per cent. of total milk solids, notwithstanding that a large number of them were collected from sources where there were very good reasons for believing that watering and skimming were being practised. Among them were 26, or 2 per cent., which were found to contain annotto coloring matter. In this connection the recently published report, with illustrations, made by Prof. J. Schirmer, upon annotto paste, is of interest. In it he says that every one of the very many samples of paste which he has examined he has found to be infested with a parasitic worm, very similar in appearance to, and of the same natural order with, *trichina spiralis*, so well known as often infesting swine.

The following were the results of my analysis of these milks, of which 76 of those falling between 12 and 13 per cent. occurred in May and June, during which months the minimum limit is 12 per cent. total solids : —

Number above the standard,	818	
Number below the standard,	443	
Total,		1,261

Number	having	more than 15 per cent. of total solids,					55
"	"	between 14 and 15 per cent. of total solids,					146
"	"	"	13 and 14	"	"	"	517
"	"	"	12 and 13	"	"	"	367
"	"	"	11 and 12	"	"	"	99
"	"	"	10 and 11	"	"	"	36
"	"	"	9 and 10	"	"	"	12
"	"	"	8 and 9	"	"	"	4
Number having less than 8 per cent. of total solids,							0
Number samples of skimmed milk above the standard,							24
Number samples of skimmed milk below the standard,							1
Number samples of colored milk,							26

Respectfully submitted,

BENNETT F. DAVENPORT,

Analyst.

PROFESSOR GOESSMANN'S REPORT.

WESTERN MASSACHUSETTS.

The following is a summary of the results of examination of the samples of milk obtained by the inspectors of the State Board of Health in the cities and towns of western Massachusetts, during the year ending Sept. 30, 1889 : —

The whole number of samples examined was	300
The number above the standard was	247
The number below the standard was	53
Percentage below standard, ...	17.7

The details of the examinations in the different cities and towns are presented in the following table. It is worthy of notice that in none of the cities and towns named in the table did the number of poor samples of milk obtained by the inspectors of the Board exceed twenty-five per cent. of the whole number, while, in the cities and towns of eastern Massachusetts, the cities and towns in which milk below the standard is largely sold are the rule rather than the exception.

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.	Colored.
Adams, ...	10	9	1	10.00	–	–
Amherst, ...	1	1	–	–	–	–
Chicopee Falls, . . .	12	10	2	16.66	–	–
Greenfield, ...	12	10	2	16.66	–	–
Holyoke, ...	36	29	7	19.44	1	–
Lenox, ...	9	8	1	11.11	–	–
North Adams, . . .	34	30	4	11.76	2	–
Northampton, . . .	12	9	3	25.00	–	–
Orange, ...	12	10	2	16.66	–	–
Palmer, ...	10	9	1	10.00	–	–
Pittsfield, ...	46	36	10	21.74	–	–
Springfield, ...	47	37	10	21.27	–	–
Turner's Falls, . . .	23	20	3	13.04	2	–
Ware, ...	24	20	4	16.66	2	–
Westfield, ...	12	9	3	25.00	–	–
Total, ...	300	247	53	17.66	7	0

CHARLES A. GOESSMANN.

REPORT OF THE ANALYST OF DRUGS.

DR. DAVENPORT'S REPORT UPON DRUGS.

BOSTON, Oct. 1, 1889.

S. W. ABBOTT, M.D., *Secretary of the State Board of Health.*

SIR: — I have the following report to make upon my examination of the 600 samples of drugs which were submitted to me for analysis during the past twelve months. Of these, 503, or 83.83 per cent., were found to be of the proper standard quality, as called for by the statute. This is a marked improvement upon the results of the previous year, when they were found to be better than ever before since the passage of the food and drug acts.

Among the drugs examined were 10 samples of powdered opium. These, assayed by the official method of the United States Pharmacopœia, yielded the following per cents. of morphia: —

Between	14.6	and	14.7	per cent. of	morphia,	1	sample.
"	14.2	"	14.3	"	"	2	"
"	13.7	"	13.8	"	"	1	"
"	13.6	"	13.7	"	"	1	"
"	13.5	"	13.6	"	"	2	"
"	12.7	"	12.8	"	"	1	"
"	12.6	"	12.7	"	"	1	"
"	11.5	"	11.6	"	"	1	"

Of tincture of opium there were 42 samples examined; and these, by the same method of assay, yielded the following results: —

Between	2.30	and	2.40	per cent. of	morphia,	1	sample.
"	1.50	"	1.60	"	"	2	"
"	1.40	"	1.50	"	"	4	"
"	1.30	"	1.40	"	"	2	"
"	1.20	"	1.30	"	"	12	"
"	1.10	"	1.20	"	"	9	"
"	1.00	"	1.10	"	"	5	"
"	0.90	"	1.00	"	"	4	"
"	0.80	"	0.90	"	"	1	"
"	0.70	"	0.80	"	"	1	"
"	0.30	"	0.40	"	"	1	"

Of morphia salts, the 2 samples examined were both of standard quality.

Of simple cinchona alkaloid salts, out of 33 samples all but 3 were found to be of proper quality.

Of citrate of iron and quinine, the 23 samples in the form of scales yielded the following results upon assay: —

Between	14	and	15	per cent.	of alkaloid,	1	sample.
"	13	"	14	"	"	5	"
"	12	"	13	"	"	12	"
"	11	"	12	"	"	4	"
"	10	"	11	"	"	1	"

Of the six samples dispensed upon a written order calling for *Liq. Ferri et Quininæ Citratis*, the following results were obtained: —

Between	4.	and	5.	per cent.	of alkaloid,	1	sample.
"	2.	"	4.	"	"	0	"
"	1.	"	2.	"	"	3	"
"	0.5	"	1.0	"	"	2	"

The apothecaries dispensing seemed to have entirely ignored the fact that this is an officinal title for a preparation of the United States Pharmacopœia, which should contain six per cent. of quinine, and to have put up simply a solution of the scale salt in no definite proportion.

Of 3 samples of alcohol and 4 samples of wines, all of the first, and this year all of the second, also were found to be of their proper quality. It has hitherto been my experience to find but a small proportion of the wines and distilled spirits submitted for examination to be of their proper pharmacopœial quality; that is, to be the natural article, mellowed only by time. The United States Commissioner of Internal Revenue says, in his last annual report:

There appears to be a class of distillers who desire to market their product as soon as possible, and who, by heavily charring their barrels, adding a little caramel or prune-juice, or by some of the so-called ageing processes, endeavor so to color their new and colorless whiskeys as to deceive the consumer. . . . From the analyses of the bourbon and rye whiskeys received direct from the distillers, and representing as they do average samples of one to

four years old goods, it may be concluded that no whiskey produced from corn or rye and stored in oaken barrels from one to four years should contain more than 0.145 per cent. of total solids, 84.56 grains per United States gallon of 231 cubic inches, or more than 5 grains of reducing sugars. . . . The deleterious effects of raw spirits are attributable to the presence of the higher-boiling alcohols, which, by slow oxidation, by exposure to the air, are more or less changed and converted into certain ethers which are comparatively harmless. . . . A large proportion of the cheapest whiskeys found in our markets is made by rectifiers by diluting "pure neutral" or "cologne" spirits to proof strength with water, adding some burnt sugar, caramel or prune-juice, to color it, and certain artificial essences with a little tannin to give the desired flavor. Innumerable recipes are known to the trade for compounding from a barrel of cologne spirits, brandy, whiskey, either rye or bourbon, and gin, as may be required. A slightly higher grade of cheap whiskey is made by adding one part of a highly flavored whiskey to three parts of cologne spirits, diluted to proof strength.

Of 31 samples of spirits of nitrous ether, 21 were markedly deficient in strength. They yielded, on assay, as follows: —

Between	4.	and	5.	per cent.	of	ethyl nitrite,	2	samples.
"	3.	"	4.	"	"	"	5	"
"	2.	"	3.	"	"	"	6	"
"	1.	"	2.	"	"	"	12	"
"	0.50	"	1.00	"	"	"	2	"
"	0.25	"	0.50	"	"	"	3	"
"	0.10	"	0.25	"	"	"	1	"

Of 23 samples of compound spirits of ether, 16 were found to be destitute of its principal ingredient, the heavy ethereal oil. Of the great need of correcting this very general omission of the most important ingredient in this preparation, I have made sufficient comment in my previous reports.

Of chloroform 23 samples, and of iodoform 36 samples, were all found to be of proper quality.

Of syrups 19 samples, and of glycerine 1 sample, were likewise found to be of good quality.

Of the officinal acids, 60 out of 64 samples corresponded with the required quality.

Of 14 bismuth preparations, all conformed to the requirements.

Of 24 magnesia preparations, all but 3 were as they should be. These 3 contained sulphate in place of the citrate.

Of 5 so-called distilled water, 3 proved to be ordinary tap water.

Of 17 samples of tincture of nux vomica, which should contain exactly 2 per cent. of solid residue, the following amounts were obtained upon assay : —

Between	5.0	and	5.5	per cent. of	residue,	1	sample.
"	3.0	"	3.5	"	"	1	"
"	2.5	"	3.0	"	"	1	"
"	2.0	"	2.5	"	"	4	"
"	1.5	"	2.0	"	"	5	"
"	1.0	"	1.5	"	"	3	"
"	0.5	"	1.0	"	"	2	"

Of the 41 samples of officinal solid extracts examined, all proved to be of good quality ; likewise all of the 24 starches, 50 spices and 34 samples of lycopodium ; while, of the 20 samples of the oils, all but one proved good.

Of the 3 samples of musk submitted, all proved to be of good commercial quality.

Of the 16 proprietary preparations examined for the presence of poisonous ingredients, all were found free except "Rat Dynamite," which, like "Rough on Rats," proved to be white arsenic colored gray by a very small admixture of carbon in a fine powder.

Respectfully submitted,

BENNETT F. DAVENPORT.

REPORT OF INVESTIGATIONS

OF THE

STATE BOARD OF HEALTH

UPON THE

POLLUTION OF ICE SUPPLIES.

Commonwealth of Massachusetts.

To the General Court of Massachusetts.

By chapter 84 of the Resolves of 1888, the General Court directed the State Board of Health to "make a special investigation with reference to the pollution of ponds, lakes, streams or other bodies of water used as ice supplies in this State, especially with reference to the effect of such pollution upon the healthfulness of such ice for domestic use."

In accordance with this direction, the State Board of Health sent to every city and town in the State printed circulars, — to the local boards of health, to physicians, or to persons known to have an interest in the subject, asking their co-operation and their replies to the following questions: —

1. Names of companies, firms or individuals who cut or sell ice in your city or town, and sources from which such ice is obtained.
2. What contaminating causes, if any, pollute the sources from which ice is cut?
3. Have any cases of illness come to your knowledge from the use of ice cut from such sources?
4. What remedies do you suggest for the prevention of such pollution?

In the responses to these circulars from one hundred and eighty-nine cities and towns, sources of pollution were noted in thirty. The answers to the third question were generally, "No." A few cases were, however, noted, where the ice supply was suspected of being the cause of illness, but none appeared to be so definitely connected with this cause as to give promise of additional knowledge if investigated further.

From the thirty sources where contaminating causes of pollution were noted there were selected twelve which appeared to be the most polluted; and in October, 1888, samples of the water from each of these sources as it then existed, and samples of the ice in ice houses adjacent, were examined, with the following average result: —

Average of Analyses of Water and of Ice from Polluted Sources in October, 1888.

	Color.	Loss on Ignition.	Fixed Residue.	Ammonia.		Chlorine.	Nitrates.	Nitrites.	Bacteria.
				Free.	Albuminoid.				
Water, ...	0.24	1.65	6.94	0.0143	0.0206	1.18	0.0343	0.0009	–
Ice, ...	0.00	0.24	1.00	0.0022	0.0027	0.01	0.0045	0.00005	138
Per cent., . . .	–	15.	14.	15.	13.	–	13.	6.	–
One sample of ice from an unpolluted source gave the following: —									
	0.0	0.20	0.20	0.0000	0.0000	0.00	0.0050	0.0000	0

The samples of ice from the twelve most polluted sources, obtained from ice houses in October, when compared with the water of the various ponds, as it was in October, showed that in the ice the color and salt had been removed, and that all but about thirteen per cent. of the other impurities of the water, as shown by chemical analyses, had been removed.

The number of bacteria in the ice averaged 138, being increased by one sample of snow ice that contained 1,246 per cubic centimetre, while the clear part of the same cake had but 6. Two samples had none; three had less than 10; three others had between 10 and 100, and two had 199 and 433.

A single sample of clear ice from an unpolluted source was found to be nearly as free from organic impurities as distilled water.

These preliminary examinations indicated, as had been found by Dr. T. M. Prudden,* in examining Hudson River

* On Bacteria in Ice and their Relations to Disease, with Special Reference to the Ice Supply of New York City. By T. Mitchell Prudden, M.D. New York, 1887. "The Medical Record," Vol. 31, Nos. 13, 14.

ice, that different parts of a cake of ice may differ much in quality; and it was concluded to follow Dr. Prudden's method of making separate examinations of transparent and of snow ice. This classification was used in examinations of the ice crop of 1888-89. Experiments were planned by which the qualities of ice found under differing circumstances could be determined; but the short season in which ice formed, — limited to the latter part of February and the first of March in 1889, — and the almost entire failure of the ice crop in 1889-90, have prevented the carrying out of these investigations; so that the Board, while presenting the facts that have been obtained and some of the conclusions to which these lead, is unable to present demonstrations of all of the interesting problems that enter the investigation required by the resolve.

As has been stated, examinations were first made of water and ice from the twelve sources which by the reports appeared to be those most polluted. On continuing the investigation other sources were included, making in all fifty-eight localities, some of which were from excellent water.

The results are all included in the appended tables. In these tables are given chemical analyses of 76 samples of water and 236 samples of ice. Most of the samples were also examined for microscopic organisms and for bacteria.

In tabulating the results of microscopical examinations, the figures represent the number of thousands of organisms in 200 cubic centimetres of water or of ice. The smallest figure given is 0.1, which expresses 100 organisms in 200 c.c. of water or of ice; where the number observed was less than 100, they are said to be "present."

The figures under bacteria express the actual number found in one cubic centimetre of the water or ice.

The number of bacteria was found to vary much in different parts of a cake of ice. The division adopted in the first season into snow ice and transparent ice made one important distinction, but others were found necessary; and in the second season three divisions were made; viz., snow ice, bubbly ice and clear ice, also top ice and bottom ice; and in the tables the remarks at the right of the columns often

indicate that the chemical analysis was made from snow ice or from the top or bottom of the cake, while the columns for bacteria show that two or more samples from the same part of the cake were examined, because there were portions of clear ice and of bubbly ice in each.

In the earlier examinations, when all of the samples were included in snow ice and transparent ice, the latter included much that was bubbly; and, when clear and bubbly ice took the place of transparent, the clear ice included some which was somewhat bubbly. If the ice crop of the present season had not failed, the Board would have made other distinctions to include the circumstances under which the ice is formed.

From the examinations that have been made, it appears probable that, when ice first forms on the surface of a pond or river, a considerable part of the impurity in the water near the surface is entangled in the first inch or less in depth, and that the ice that forms below this first inch contains but a very small percentage of the impurities of the water. If snow falls upon the thin ice, causing it to sink, so that water from below saturates the snow, it will freeze without purification; or, if rain falls upon the snow and freezes, the ice thus formed contains the impurities of the snow and of the rain water, and whatever else may have settled out of the air. The method, often pursued, of flooding the ice of a pond or river, by cutting holes through it, gives a layer of ice as impure as the water of which it is formed.

From all of the analyses of water and of ice taken at the same time, so that they can be fairly compared, twelve have been selected in which the sum of ammonias in the water indicated the greatest pollution, and the principal results of analyses are given in the following table: —

Millbury. — Blackstone River.

	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as		Bacteria.	
		Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.5	3.00	11.30	.1680	.0440	.74	.0150	.0018	3762	-
Snow ice,	0.0	1.70	2.90	.0448	.0306	.10	.0020	.0003	-	1586
Ice,	0.0	1.10	2.15	.0252	.0176	.10	.0050	.0003	241	-
Per cent. { Snow ice,	-	57	26	27	70	14	13	17	-	42
Per cent. { Ice,	-	37	19	15	40	14	33	17	6	-

Northbridge. — Pond fed by Blackstone River.

	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.3	-	-	.0600	.0370	.50	.0200	.0006	74	-
Ice,	0.0	1.65	0.85	.0006	.0030	.01	.0030	.0001	43	-
Per cent.,	-	-	-	1	8	2	15	17	60	-

Lowell. — Black Brook.

	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.0	-	-	.0686	.0142	.40	.0600	.0003	107	-
Snow ice,	0.0	1.40	2.50	.0184	.0128	.04	.0060	.0001	-	39
Ice,	0.0	0.55	0.45	.0036	.0040	.01	.0050	.0000	3	-
Per cent. { Snow ice,	-	-	-	27	90	10	10	33	-	37
Per cent. { Ice,	-	-	-	5	28	2	8	0	3	-

Jamaica Pond.

	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.05	-	-	.0120	.0664	.86	.0450	.0002	147	-
Ice,	0.0	0.35	1.10	.0034	.0060	0.0	.0040	.0001	1	-
Per cent.,	-	-	-	28	9	0	9	50	1	-

Worcester. — Crescent Street Pond.

	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.15	-	-	.0356	.0356	.70	.0850	.0007	1200	-
Snow ice,	0.0	-	-	.0046	.0094	.03	-	-	-	58
Ice,	0.0	0.45	1.10	.0006	.0026	.01	.0060	.0000	16	-
Per cent. { Snow ice,	-	-	-	13	26	4	-	-	-	5
Per cent. { Ice,	-	-	-	2	7	1	7	0	1	-

Brighton. — Hollis Pond.

	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water,	0.1	-	-	.0354	.0296	1.59	.4000	.0031	20000	-
Ice,	0.0	0.30	0.60	.0012	.0022	.00	.0030	.0000	702	-
Per cent.,	-	-	-	3	7	0	1	0	3	-

Dorchester.—King's Pond.

	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as		Bacteria.	
		Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.	Water or Ice.	Snow Ice.
Water, ...	0.2	–	–	.0314	.0262	1.19	.0800	.0013	412	–
Ice, ...	0.0	0.50	1.10	.0028	.0044	.01	.0030	.0000	6	–
Per cent., . . .	–	–	–	9	17	1	4	0	1	–

Newton.—Hammond's Pond.

Water, ...	1.1	–	–	.0038	.0450	.54	.0040	.0003	115	–
Ice, ...	0.0	0.20	0.55	.0000	.0012	0.0	.0030	.0000	8	–
Per cent., . . .	–	–	–	0	3	0	75	0	7	–

Arlington.—Little Spy Pond

Water, ...	0.2	–	–	.0058	.0390	1.70	.1750	.0020	1029	–
Ice, ...	0.0	0.68	2.68	.0026	.0068	.02	.0020	.0000	11	61
Per cent., . . .	–	–	–	45	17	1	1	0	1	6

Melrose.—Ell Pond.

Water, ...	0.2	–	–	.0240	.0202	.94	.0650	.0009	–	–
Ice, ...	0.0	0.68	2.20	.0020	.0028	.02	.0050	.0000	2	11
Per cent., . . .	–	–	–	8	14	2	8	0	–	–

Cambridge.—Fresh Pond.

Water, ...	0.05	–	–	.0230	.0180	1.00	.0300	.0008	11	–
Ice, ...	0.0	0.56	0.80	.0022	.0030	.02	.0020	.0000	3	–
Per cent., . . .	–	–	–	10	17	2	67	0	27	–

Woburn.—Horn Pond.

Water, ...	0.25	–	–	.0172	.0210	.67	.0200	.0007	327	–
Ice, ...	0.0	0.25	0.60	.0010	.0028	.02	.0000	.0000	3	–
Per cent., . . .	–	–	–	6	13	3	0	0	1	–

The chemical results are given in parts per 100,000.

The bacteria are indicated by the number found in a cubic centimetre.

The percentage of each substance of the water that remained in the ice or in snow ice is given.

These waters all contain more ammonias than are desirable in drinking waters; but the ice formed from these waters contains from three to twenty-one per cent. as much as the waters, averaging eleven per cent. The amount of ammonias contained in the ice, except in the one containing the largest amount, would not cause them to be condemned as drinking waters; neither would the number of bacteria, except in the case of ice from the Blackstone River and from Hollis Pond in Brighton. But we cannot depend upon numbers alone. A large number of bacteria of one kind may be harmless, and a small number of another kind may communicate a most serious disease. It is known, from these experiments as well as from others, that many kinds of bacteria survive a long season in ice; and it has been shown by Dr. Prudden that the bacillus of typhoid fever will live in decreasing numbers in ice for three months at least. It is, then, the quality of the bacteria rather than the quantity that we are to consider, and the best judgment in regard to this includes the source from which they came. If the source is one which is liable to be polluted by disease-producing bacteria, as is likely to be the case wherever sewage enters, this fact should have much more weight than the small number of bacteria found.

The purifying effect of freezing is greater upon substances that are in solution than it is upon those in suspension. For example, upon freezing the upper part of a body of sewage to the depth of one inch, the substances in solution were reduced as given below: —

	Sewage.	Ice.	Per Cent. remaining in Ice.
Loss on ignition,	10.4	1.8	17
Fixed residue,	19.6	2.2	11
Free ammonia,	1.646	0.184	11
Albuminoid ammonia,	0.250	0.012	5
Chlorine,	4.20	0.52	12

The parts in suspension were affected as follows: —

Loss on ignition,	2.8	1.9	68
Fixed residue,	2.3	1.6	70
Albuminoid ammonia,	0.130	0.036	28

Of the parts that were in solution in the sewage, the freezing process caused to be removed all of the impurities except from 5 to 17 per cent., while of the much smaller parts which were in suspension there remained in the ice from 28 to 70 per cent.

The unfrozen sewage under the ice contained the impurities which the ice had expelled.

It appears that the parts that are in suspension, particularly particles that have some buoyancy in water, are not so easily expelled as the parts that are in solution. This is confirmed by the fact that a large part of the organic matter, one-half or three-quarters and sometimes more, that is found in good ice, is of particles in suspension, and is readily removed by filter paper.

The inch in depth of frozen sewage contained 10 per cent. of the organic impurity of the sewage, as indicated by the sum of ammonias; and from other experiments we have reason to conclude that, if another inch in depth had formed under the first, it would have contained a still smaller percentage of organic impurity; but if the first inch had been pressed down, and the sewage had risen above it and then frozen, this last layer would have been as impure as the sewage. This is an extreme case of impurity of the source.

Taking an average of all of the water and ice used for ice supplies, which we have examined, we find that the organic impurities of the snow ice, as shown by the sum of ammonias, amount to 69 per cent. of those of the waters; that the organic impurities of all the ice except the snow ice amount to 12 per cent., and those of what we have called clear ice amount to 6 per cent., of the impurities of the waters. The color of the waters was entirely removed, and the salt that they contained was nearly all removed, by the process of freezing.

There were 81 per cent. as many bacteria in the snow ice as in the waters; 10 per cent. as many in all other ice, and 2 per cent. as many in the clear ice, as in the waters.

While the Board, as before stated, was unable in these warm winters to make the experiments desired to settle many points of the inquiry, the results obtained lead to the conclusions that, while clear ice from polluted sources may

contain so small a percentage of the impurities of the source that it may not be regarded as injurious to health, the snow ice and any ice, however clear, that may have been formed by flooding, is likely to contain so large a percentage of the impurities of the source, and with these impurities some of the disease germs that may be in the source, that the Board feels bound to warn the public against using ice for domestic purposes that is obtained from a source polluted by sewage beyond that which would be allowable in a drinking water stream or pond; and that in general it is much safer to use, for drinking water and for placing in contact with food, that portion of the ice that is clear.

H. P. WALCOTT,
HIRAM F. MILLS,
THORNTON K. LOTHROP,
E. U. JONES,
JULIUS H. APPLETON,
FRANK W. DRAPER,
JOSEPH W. HASTINGS,
State Board of Health.

TABLES

OF

ANALYSES OF WATER AND OF ICE,

CONTAINING MANY SAMPLES FROM POLLUTED SOURCES, AND SOME FROM UNPOLLUTED SOURCES.

WATER AND ICE FROM ARLINGTON.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	5	Distinct, some sli't greenish.	–	0.0	2.05	12.75	.0242	.0418 .0334	2.57	.0500	.0028
1888	Dec.	6	Distinct, slight.	–	0.05	3.25	12.30	.0768	.0352 .0280	2.21	.1300	.0043
1889	Feb.	28	Distinct, very sli't.	–	0.05	3.05	13.70	.0066	.0380 .0290	2.16	.1510	.0021
1888	Dec.	6	Decided, cons. yellow.	–	0.2	3.50	9.45	.0000	.0416 .0260	1.49	.2600	.0019
1889	Feb.	28	Decided, br't green cloud at top.	–	0.2	3.15	13.40	.0058	.0390 .0262	1.70	.1750	.0020

Analyses of Ice.

1888	Oct.	5	Cl'r, a little lig't & a little heavy bl'k.	–	0.0	0.35 0.15	2.10 0.45	.0062	.0054 .0034	.00	.0050	.0001
1888	Dec.	6	Very sli't, slightly white.	–	0.0	0.40 0.40	0.45 0.10	.0076	.0056 .0034	.00	.0040	.0001
1889	Feb.	28	None.	Earthy & black.	0.0	0.76 0.20	0.36 0.60	.0022	.0010 .0006	.01	.0040	.0000
1890	Feb.	12	V. slight.	Considerable, dark.	0.0	0.40	1.80	.0036	.0016 .0008	.01	.0080	.0000
1890	Feb.	12	V. slight.	V. slight.	0.0	–	–	.0028	.0002 .0002	.00	.0050	.0000
1888	Oct.	5	Clear.	A little lig't & a little heavy black.	0.0	0.35 0.30	2.25 0.35	.0006	.0036 .0022	.00	.0070	.0001
1889	Feb.	28	Clear.	Heavy bl'k & some light colored.	0.0	0.68 0.40	2.68 0.36	.0026	.0068 .0016	.02	.0020	.0000
1890	Feb.	12	Slight.	Heavy da'k, dirty.	0.0	1.10	6.70	.0114	.0104 .0026	.06	.0120	.0001
1890	Feb.	12	V. slight.	Considerable, dark.	0.0	–	–	.0000	.0004 .0002	.00	.0080	.0000
1890	Feb.	12	V. slight.		0.0	–	–	.0000	.0014 .0006	.00	.0070	.0000
1890	Feb.	19	V. slight.	Considerable.	0.0	2.75	13.85	.0106	.0192 .0030	.12	.0150	.0002
1890	Feb.	19	None.	Slight, bl'k & earthy.	0.0	–	–	.0008	.0020 .0014	.02	.0040	.0000
1890	Feb.	19	None.	V. slight.	0.0	–	–	.0000	.0000 .0000	.02	.0050	.0000

WATER AND ICE FROM ARLINGTON.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Spy Pond.*
36.0	pr.	0.0	pr.	–	Upper end, at A. Gage & Co.'s ice house.
100.0	168.1	0.0	1.0	274	From platform of Arlington Boat Club House, 300 yds. from A. Gage & Co.'s ice houses.
pr.	12.6	0.0	5.2	145	Where ice had been cut before.
					Little Spy Pond.†
0.0	17.2	0.0	250.0	6460	Off ice float.
pr.	20.8	0.0	25.0	1029	Where ice had been cut shortly before.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Spy Pond.
0.0	0.0	0.0	0.0	10	–	–	–	Ice of 1887–88, from A. Gage & Co.'s ice house.
0.0	0.0	0.0	0.0	–	3	53	–	Ice of 1887–88, from A. Gage & Co.'s upper ice house.
0.0	pr.	0.0	0.0	–	0	7	–	From ice house of C. O. Gage. Block 7½ in. thick, 4½ in. clear, 3 in. bubbly.
0.0	2.7	0.0	0.0	–	–	12	–	Top of cake. Cake 16 in. by 12 in., 5½ in. thick.
0.1	0.0	0.0	0.0	–	–	11	–	Bottom of cake.
								Little Spy Pond.
0.0	pr.	0.0	0.0	27	–	–	–	Ice of 1887–88. From ice house of H. D. & W. S. Durgin.
0.0	pr.	0.0	0.0	–	11	–	61	From ice house of H. D. & W. S. Durgin. Contains much foreign matter.
0.0	0.3	0.0	0.0	–	–	–	432	Top of cake. Cake 13 in. long, 12 in. wide, 9½ in. thick. Ice of 1888–89.
0.0	0.0	0.0	0.4	–	–	0	–	Middle of cake.
0.0	0.6	0.1	0.1	–	8	–	–	Bottom of cake.
–	–	–	–	–	–	–	150	Ice of 1890. Top of cake. Cake 9½ in. by 14 in. by 6 in.
0.0	0.0	0.2	0.2	–	–	17	–	Middle of cake.
0.0	0.0	0.1	0.0	–	–	22	–	Bottom of cake.

* Area about 150 acres; is in a populous region, and receives drainage from houses and market gardens. † Area about 30 acres, below the outlet of Spy Pond.

WATER AND ICE FROM ATTLEBOROUGH.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	4	Slight, milky.	Slight, whitish.	0.2	1.25	3.00	.0114	.0126 .0100	.36	.0300	.0005
1889	Mar.	4	V. slight.	None.	0.4	1.35	2.15	.0002	.0130 .0128	.28	.0070	.0002

Analyses of Ice.

1889	Mar.	4	None.	Slight.	0.0	0.44 0.32	0.16 0.08	.0002	.0014 .0006	.01	.0060	.0000
1889	Mar.	4	None.	Cons., num. bl'k specks.	0.0	0.40 0.24	0.64 0.12	.0000	.0014 .0012	.01	.0050	.0000

WATER AND ICE FROM BROCKTON.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	31	Slight.	A little, brown.	1.3	1.90	4.00	.0084	.0244 .0198	.84	.0500	.0012
1889	Mar.	4	Slight.	V. slight.	0.2	1.35	3.85	.0166	.0162 .0128	.81	.1000	.0010

WATER AND ICE FROM ATTLEBOROUGH.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Deanville Pond.*
0.0	1.4	0.0	0.1	122	From centre of pond. Water 3 ft. lower than when ice was cut.
					Thatcher's Pond.†
0.0	0.1	0.0	0.0	73	From J. Thatcher's ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Deanville Pond.
0.0	0.0	0.0	0.0	–	2	5	0	From the H. L. Manchester ice house. Block 5¾ in. thick.
								Thatcher's Pond.
0.0	0.1	0.0	0.0	–	–	0	–	From J. Thatcher's ice house. Block 9 in. thick.

WATER AND ICE FROM BROCKTON.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Factory Pond.‡
0.0	2.1	0.0	0.0	–	Near the centre of the city. Receives factory drainage and some sewage.
0.0	0.4	0.0	pr.	116	From the ice channel.

* Above dam on Ten Mile River.

† Above dam on Ten Mile River, and below Attleborough.

‡ Area about 5 acres.

WATER AND ICE FROM BROCKTON — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	31	V. slight.	V. slight.	0.0	0.10 .00	0.30 .25	.0000	.0000 .0000	.01	.0040	.0000
1889	Mar.	4	Clear.	Cons., bl'k specks.	0.0	0.40 0.30	1.00 1.00	.0000	.0012 .0006	.01	.0020	.0000

WATER AND ICE FROM BRIGHTON.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	16	Distinct.	Slight.	0.1	1.40	3.95	.0020	.0286 .0178	.55	.0280	.0005
1889	Mar.	16	Distinct.	Cons., flocculent and greenish.	0.1	4.55	9.60	.0354	.0296 .0164	1.59	.4000	.0031

Analyses of Ice.

1889	Mar.	16	V. slight.	Slight, earthy.	0.0			.0006	.0030	.02	.8000	
1889	Mar.	16	None.	Slight, white.	0.0	0.25 0.00	0.40 0.45	.0000	.0018 .0008	.00	.0000	.0000
1889	Mar.	16	None.	Considerable, earthy and black.	0.0			.0064	.0086	.02		
1889	Mar.	16	None.	Sl't, earthy and black.	0.0	0.30 0.15	0.60 0.10	.0012	.0022 .0014	.00	.0030	.0000

WATER AND ICE FROM BROCKTON — Concluded.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Factory Pond.
0.0	0.0	0.0	0.0	6 190 8		Dif. pcs.	–	From the ice house. Ice of 1887-8.
0.0	0.0	0.0	0.0		2	4	–	From the ice house. Cut March 2.

WATER AND ICE FROM BRIGHTON.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Strong's Pond.*
0.0	606.1	0.0	0.2	287	Downing's ice house pier.
					Hollis' Pond.†
0.0	44.2	0.0	60.0	20,000	Hollis' ice house pier.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Strong's Pond.
0.0	pr.	0.0	pr.	–	–	32	–	From J. R. Downing's ice house. Block 8 in. thick. Upper ⅓ of sample.
0.0	0.1	0.0	0.0	–	–	23	–	From J. R. Downing's ice house. Lower ⅔ of sample.
								Hollis' Pond.
0.0	0.4	0.0	0.0	–	–	14	–	From Hollis' ice house. Block 8½ in. thick. Upper ¼ of sample.
0.0	pr.	0.0	0.0	–	–	702	–	From Hollis' ice house. Lower ¾ of sample.

* Area 10 to 15 acres; no inlet. † Area about one acre. A filthy pond.

WATER AND ICE FROM CAMBRIDGE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	27	V. slight.	V. slight.	0.05	2.50	7.60	.0230	.0180 .0162	1.00	.0300	.0008

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1888	Nov.	8	Clear.	None.	0.0	0.00 0.00	0.35 0.05	.0000	.0012 .0000	.00	.0040	.0001
1889	Feb.	27	None.	Heavy bl'k.	0.0	0.56 0.28	0.80 0.32	.0022	.0030 .0010	.02	.0020	.0000

WATER AND ICE FROM CONCORD.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	27	V. slight.	None.	0.7	1.90	2.70	.0010	.0204 .0174	.26	.0070	.0001

Analysis of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1889	Feb.	27	None.	Sli't, dark earthy.	0.0	0.50 0.40	0.60 0.20	.0010	.0012 .0012	.02	.0020	.0002

WATER AND ICE FROM CAMBRIDGE.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Fresh Pond.*
0.0	0.3	0.0	60.1	11	Water from the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Fresh Pond.
0.0	0.0	0.0	0.0	–	13	29	–	Ice of 1887-88 from ice house of Boston Ice Co.
0.0	pr.	0.0	0.1	–	1	3	–	Freshly cut from ice field, block 10½ in. thick.

WATER AND ICE FROM CONCORD.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Warner's Pond.†
0.0	0.0	0.0	0.0	120	From the N. W. side.

Analysis of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Warner's Pond.
0.0	0.0	0.0	0.0	–	0	0	–	From the ice field of J. K. Morrill, block 15½ in. thick.

* The banks of this pond are largely controlled to keep it from pollution.

† Has sandy bottom and banks.

WATER AND ICE FROM DANVERS.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	2	Slight.	V. slight.	0.2	2.25	6.65	.0030	.0186 .0122	1.53	.0800	.0010

Analysis of Ice.

1889	Mar.	2	V. slight.	Cons., both hea'y, bl'k and floc't.	0.0	0.25 0.15	1.35 0.30	.0008	.0034 .0016	.02	.0020	.0000

WATER AND ICE FROM DORCHESTER.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Nov.	14	Slight.	A little, light.	1.6	2.50	3.05	.0024	.0320 .0264	.53	0080	.0002
1889	Mar.	2	Decided.	A little, flocculent.	0.7	1.60	4.30	0012	.0306 .0244	.84	0180	.0004
1889	Feb.	21	Decided, milky.	V. slight.	0.2	2.30	6.70	0314	.0262 .0222	1.19	0800	.0013

Analyses of Ice.

1888	Nov.	14	Slight.	Cons., some light col'd, flocculent.	0.0	0.45 0.10	0.75 0.35	.0008	.0066 .0008	.00	.0050	.0000
1889	Mar.	2	V. slight.	Consid'ble, black and flocculent.	0.0	0.28 0.40	1.44 0.15	.0008	.0030 .0022	.01	0001	.0001
1889	Feb.	21	Clear.	Heavy, bl'k & some lig't flocculent.	0.0	0.50 0.20	1.10 0.30	.0028	.0044 .0010	.01	.0030	.0000

WATER AND ICE FROM DANVERS.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Putnam Pond.*
0.0	0.2	0.0	pr.	32	From O. Putnam's ice field.

Analysis of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Putnam Pond.
0.0	pr.	0.0	0.0	–	9	8	31	Freshly cut from the ice field.

WATER AND ICE FROM DORCHESTER.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Neponset River.†
0.0	0.4	0.0	pr.	1596	Opposite Abbott's ice house.
0.0	pr.	0.0	0.0	326	Opposite Abbott's ice house.
					King's Pond.‡
0.0	0.0	0.0	0.0	412	From the ice field of Abbott's Ice Co.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Neponset River.
0.0	0.0	0.0	0.0	–	174	257	–	Ice of 1887-88. From Abbott's ice house.
0.0	0.0	0.0	0.0	–	1	3	–	From Abbott's ice house. Block 7⅛ in. thick.
								King's Pond.
0.0	0.1	0.0	0.0	–	1	6	–	From the ice field of Abbott's Ice Co. Block 8½ in. thick.

* Area about 5 acres. Fed by springs and two brooks.

† Above the dam of the Tileston and Hollingsworth Paper Mill.

‡ A flowed meadow, about 2 acres, on Churchill Brook.

WATER AND ICE FROM FREETOWN (ASSONET).

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	14	V. slight.	None.	1.3	1.80	1.70	.0020	.0244 .0196	.32	.0040	.0001

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1889	Feb.	14	None.	Slight, black.	0.0			.0002	.0020	.01	.0020	–
1889	Feb.	14	None.	V. slight.	0.0	0.20 .05	0.45 .05	.0000	.0014 .0012	.00	.0020	.0001

WATER AND ICE FROM GARDNER.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	16	Slight.	V. slight.	0.05	0.80	2.05	.0006	.0156 .0106	.26	.0070	.0001
1890	Feb.	24	V. slight.	V. slight.	0.0	0.75	2.20	.0010	.0148 .0134	.26	.0090	.0001
1890	Feb.	24	V. slight.	V. slight.	0.55	1.70	2.05	.0052	.0136 .0118	.22	.0130	.0002

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1889	Feb.	16	Slight.	Slight.	0.0	0.20	0.45	.0018	.0050 .0022	.04	.0020	.0001
1889	Feb.	16	None.	Considerable, black.	0.0	0.40 0.15	1.10 0.25	.0002	.0014 .0004	.00	.0000	.0001

WATER AND ICE FROM FREETOWN (ASSONET).

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Forge Pond.*
–	–	–	–	224	From the ice field near ice house.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Forge Pond.
–	–	–	–	7	–	–	–	From the ice house. Block 6½ in. thick. Top of sample.
0.0	pr.	0.0	0.0	15	–	–	–	From the ice house. Block 6½ in. thick. Bottom of sample.

WATER AND ICE FROM GARDNER.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Crystal Lake.†
0.0	pr.	0.0	4.4	15	From the ice field, opposite the cemetery.
0.0	1.4	0.0	29.0	4004	From below the ice.
					Parker's Mill Pond.
0.0	0.3	0.0	5.2	Liq.	

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Crystal Lake.
0.0	0.0	0.0	0.0	–	–	–	16	Block 13 in. thick. This piece snow ice. Freshly cut.
0.0	pr.	0.0	0.0	–	2	7	–	The remainder of the sample.

* Made by a dam on brook near Assonet River.

† One and one-quarter miles long, ¾ mile wide. It is fed by springs and one brook.

WATER AND ICE FROM GARDNER — Concluded.

Analyses of Ice — Concluded.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	24	None.	Slight, black.	0.0	0.20	0.56	.0002	.0002 .0000	.00	.0070	.0000
1890	Feb.	24	A few suspended particles.	V. slight, black.	0.0	0.24	0.64	.0002	.0008 .0000	.02	.0080	.0000
1890	Feb.	24	None.	Slight, black.	0.0	0.08	0.44	.0000	.0000 .0000	.00	.0060	.0000
1890	Feb.	24	V. slight.	Slight, black.	0.0	0.00	0.64	.0000	.0000 .0000	.01	.0030	.0000

WATER AND ICE FROM GLOUCESTER.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	17	Slight.	V. slight.	0.1	1.30	4.05	.0032	.0196 .0142	1.13	.0500	.0005
1889	Mar.	8	Decided.	Cons., light green.	0.2	1.80	4.50	.0000	.0366 .0210	1.63	.0180	.0008
1889	Mar.	19	Decided.	Heavy, green.	0.2	1.45	4.80	.0002	.0376 .0184	1.70	.0020	.0005
1889	Mar.	8	V. slight.	V. slight.	0.15	1.50	4.55	.0004	.0132 .0092	1.34	.1000	.0003

Analyses of Ice.

1888	Oct.	17	V. slight.	A little, light.	0.0	0.15 0.05	0.55 0.20	.0002	.0020 .0004	.00	.0050	.0000
1889	Mar.	8	None.	Cons., black particles.	0.0	0.10	0.50	.0000	.0016 .0008	.01	.0020	.0001
1889	Mar.	19	V. slight.	Consid'ble, flocculent.	0.0	0.35 0.10	1.60 0.30	.0000	.0038 .0010	.02	.0000	.0000
1889	Mar.	19	None.	Slight, heavy.	0.0	–	–	.0000	.0020 .0010	.01	–	–
1889	Mar.	8	None.	Slight, bl'k specks.	0.0	0.20 0.10	1.45 0.30	.0000	.0014 .0010	.00	.0030	.0001

WATER AND ICE FROM GARDNER — Concluded.

Analyses of Ice — Concluded.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Crystal Lake — Con.
0.0	0.0	0.0	0.0	–	–	7	–	Top of cake. Cake 10 in. thick.
0.0	0.0	0.0	0.0	–	–	35	–	Bottom of cake.
								Parker's Mill Pond.
0.0	0.0	0.0	0.0	–	–	24	–	Cake 8½ in. thick. Top of cake.
0.0	0.0	0.0	0.0	–	–	50	–	Bottom of cake.

WATER AND ICE FROM GLOUCESTER.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Day's Upper Pond.*
0.0	0.0	0.0	0.0	–	From opposite ice house of the Cape Pond Ice Co.
					Day's Lower Pond.†
0.0	160.8	0.0	2.0	4836	From opposite pier of Cape Pond Ice Co.
0.0	1301.1	0.0	13.0	403	From opposite pier of Cape Pond Ice Co.
					Webster's Pond.‡
0.0	0.2	0.0	0.2	1155	Taken 5 ft. from shore near dam.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Day's Upper Pond.
0.0	pr.	0.0	0.0	0	–	–	–	Ice of 1887–88. From ice house of Cape Pond Ice Co.
								Day's Lower Pond.
0.0	pr.	0.0	0.0	–	9	1632	–	From broken cakes near ice house. Block 6 in thick. Large amount of foreign matter enclosed.
–	–	–	–	–	–	1950	–	From ice house. Block 7 in. thick. Upper ⅓ of sample and about ½ melted remainder.
–	–	–	–	21	–	–	–	Remainder of the sample.
								Webster's Pond.
0.0	0.0	0.0	0.0	–	0	2	–	From broken cakes near ice house. Block 7 in. thick.

* A small pond. Receives no house drainage, but some from the street.

† Below the upper pond. Made by a dam across a meadow.

‡ Area about two acres.

WATER AND ICE FROM HOLYOKE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	5	Slight.	Slight, flocculent.	0.1	0.70	4.15	.0002	.0078 .0064	.12	.0200	.0001

Analyses of Ice.

1889	Mar.	5	None.	Con. black particles.	0.0	1.08 0.36	0.12 0.04	.0004	.0010 .0002	Lost	.0000	.0000
1890	Feb.	12	V. slight.	Much, bl'k.	0.0	0.80	4.25	.0000	.0092 .0000	.02	.0000	.0000
1890	Feb.	12	V. slight.	Much, bl'k	0.0	1.05	4.60	.0000	.0108 .0002	.01	.0030	.0001

WATER AND ICE FROM JAMAICA POND.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	1	V. decided.	Slight, reddish white.	0.05	–	–	.0120	.0664	.86	.0450	.0002

Analyses of Ice.

1888	Mar.	12	V. slight.	Con., earthy white floc't.	0.0	0.15 0.10	0.40 0.35	.0052	.0048 .0028	.01	.0040	–
1889	Mar.	1	Slight.	Consid'ble.	0.0	0.35 0.25	1.10 0.35	.0034	.0060 .0014	.00	.0040	.0001

WATER AND ICE FROM HOLYOKE.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Connecticut River.
0.0	pr.	0.0	0.0	281	From west side of river, above dam (near sewage outlet).

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Connecticut River.
0.0	0.0	0.0	0.0	–	33	11	–	New ice. Holyoke Ice Co. Block 9 in. thick.
0.0	0.5	0.0	0.0	–	–	1	–	Ice of 1889–90. Cake 6 in. thick. Top of sample.
0.0	0.7	0.0	0.0	–	–	4	–	Bottom of sample.

WATER AND ICE FROM JAMAICA POND.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Jamaica Pond.*
0.0	0.5	100.0	0.6	147	From the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Jamaica Pond.
0.0	0.0	0.0	0.0	–	–	–	–	Freshly cut, second crop.
0.0	0.2	30.0	0.0	–	0	1	–	Freshly cut, contains a little foreign matter. Block 9½ in. thick.

* Fed by springs.

WATER AND ICE FROM JAMAICA POND — Concluded.

Analyses of Ice — Concluded.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albu-minoid.		Nitrates.	Nitrites.
1889	Mar.	25	V. slight.	Much sed.	0.0	0.58	1.10	.0080	.0214 .0048	.02	.0030	.0000
1889	Mar.	25	V. slight.	Consid'ble.	0.0	0.18	0.50	.0034	.0068 .0012	.02	.0030	.0001
1889	Mar.	25	V. slight.	Slight.	0.0	0.00	0.55	.0016	.0040 .0008	.01	.0030	.0000
1889	Mar.	25	V. slight.	Sli't, white, bl'k par'les.	0.0	–	–	.0016	.0030 .0008	.00	.0040	.0000
1889	Mar.	25	V. slight.	V. slight.	0.0	0.20	0.05	.0012	.0008 .0002	.00	.0030	.0001
1890	Feb.	5	V. slight.	Con., dark.	0.0	0.40 0.20	0.85 0.20	.0108	.0032 .0010	.04	.0080	.0005
1890	Feb.	5	V. slight.	Sli't, white.	0.0	–	–	.0024	.0020 .0018	.002	.0080	.0000
1890	Feb.	5	V. slight.	V. slight, white.	0.0	–	–	.0028	.0008 .0006	.004	.0050	.0002
1890	Feb.	5	Slight.	Con., dark and light flocculent.	0.0	0.60 0.30	0.50 0.45	.0076	.0122 .0076	.02	.0090	.0003
1890	Feb.	5	V. slight.	Sli't, dark and light.	0.0	–	–	.0012	.0036 .0018	.002	.0120	.0001
1890	Feb.	5	V. slight.	V. slight, white.	0.0	–	–	.0014	.0008 .0004	.003	.0080	.0002

WATER AND ICE FROM LAWRENCE.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albu-minoid.		Nitrates.	Nitrites.
1889	Feb.	20	Slight, milky.	Slight, black.	0.2	0.85	2.50	.0028	.0148 .0124	.18	.0050	.0004
1890	Feb.	17	Slight.	V. slight.	0.4	1.70	2.00	.0000	.0224 .0148	.25	.0100	.0000

WATER AND ICE FROM JAMAICA POND — Concluded.

Analyses of Ice — Concluded.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Jamaica Pond — Con.
0.0	0.0	300.0	0.0	–	–	616	–	Cut from pond. Block 9 in. thick. Top layer 1 in. thick. A little snow ice. Closely bubbly.
0.0	0.4	20.0	pr.	–	–	0	–	Second layer $1\frac{1}{2}$ in. thick. Less closely bubbly.
0.0	0.0	4.4	0.0	–	–	4	–	Third layer 2 in. thick. Bubbly.
0.0	0.0	4.0	0.0	–	0	–	–	Fourth layer $2\frac{1}{2}$ in. thick. Slightly bubbly.
0.0	pr.	1.0	0.0	–	4	–	–	Fifth layer. Nearly clear.
0.6	0.0	0.0	0.0	–	–	–	1664	Ice of 1887–88. Cake 10 in. thick. Top of cake. Mostly snow ice.
0.3	0.0	0.0	0.0	–	–	18	–	Middle of cake. A little bubbly, mostly clear.
0.1	0.0	0.0	0.0	–	106	–	–	Bottom of cake. Clear.
5.0	0.1	0.0	0.0	–	–	–	2607	Ice of 1887–88. Cake $9\frac{1}{2}$ in. thick. Top of cake. Closely bubbly or snow ice.
1.0	0.1	0.0	0.0	–	–	13	–	Middle of cake. Bubbly.
0.7	0.0	0.0	0.0	–	–	39	–	Bottom of cake. Nearly clear.

WATER AND ICE FROM LAWRENCE.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Merrimac River.
0.0	0.5	0.0	0.0	274	Above Holt's ice house, 100 ft. from north shore.
0.0	1.0	0.0	1.2	80	Cove, south side Merrimac River, above dam.

WATER AND ICE FROM LAWRENCE — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	20	V. slight.	Considerable.	0.0	0.05	0.55	.0034	.0026	.01	.0020	.0000
1889	Feb.	20	None.	Considerable, earthy, & black.	0.0	0.20 0.25	1.25 0.45	.0016	.0024 .0014	0.0	.0000	.0000
1889	Feb.	20	V. slight, milky.	Very much, earthy & floc't.	0.0	0.20	0.45	.0104	.0282 .0112	.03	.0020	.0001
1889	Feb.	20	Slight.	Considerable, earthy.	0.0	0.40 0.10	8.10 0.40	.0002	.0036 .0006	0.0	.0000	.0000
1890	Feb.	18	Slight, milky.	V. slight.	0.0	0.12	0.36	.0006	.0072 .0008	0.0	.0020	.0000
1890	Feb.	18	None.	Considerable.	0.0	0.40	1.80	.0004	.0034 .0010	.02	.0050	less than .0001
1890	Feb.	18	None.	Considerable.	0.0	–	–	.0002	.0078 .0002	.01	.0080	.0000

WATER AND ICE FROM LENOX.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	14	Slight, milky.	Slight, white.	1.0	1.05	13.20	.0070	.0120 .0082	.20	.0300	.0004

Analyses of Ice.

1889	Feb.	14	V. slight.	Considerable, earthy.	0.0	–	–	.0036	.0040	.04	.0050	.0002
1889	Feb.	14	V. slight.	Sli't, coarse fragments	0.0	0.05 0.00	0.60 0.50	.0000	.0012 .0008	.00	.0030	.0001
1890	Feb.	11	V. slight.	V. slight, white.	0.0	0.20	0.65	.0010	.0010 .0002	.00	.0070	.0000
1890	Feb.	11	V. slight.	V. slight, dark.	0.0	–	–	.0000	.0034 .0004	.00	.0050	.0000
1890	Feb.	11	Slight.	Considerable, white, a little dark.	0.0	0.70	1.30	.0022	.0048 .0022	.02	.0050	.0001
1890	Feb.	11	V. slight.	Considerable, dark.	0.0	–	–	.0004	.0004 .0004	.00	.0100	.0000

WATER AND ICE FROM LAWRENCE — Concluded.

Analyses of Ice.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Merrimac River.
0.0	0.0	0.0	0.0	–	2	–	–	From Holt's ice house. Block 18 in. thick. Ice of 1887–88.
0.0	1.0	0.0	0.0	–	4	7	–	Freshly cut from the river, by Holt.
0.0	75.0	0.0	0.0	–	–	–	21	From rejected pile at Holt's ice house. Block 10 in. thick. The snow ice of sample.
0.0	0.4	0.0	pr.	–	6	–	–	From rejected pile at Holt's ice house. The remainder of the block.
0.0	0.0	0.0	0.0	–	–	17	–	Cove, south side Merrimac River, above dam. Cake 3½ in. thick.
								Stevens Pond.*
0.0	0.5	0.0	0.0	–	–	110	–	Cake 4½ in. thick. Top of sample.
0.0	0.1	0.0	0.1	–	–	192	–	Bottom of sample.

WATER AND ICE FROM LENOX.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Lily Pond.†
pr.	0.3	pr.	0.0	56	From centre of pond, where ice was cut.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Lily Pond.
0.2	pr.	0.0	pr.	–	–	–	3	From blocks cut and remaining in pond. Block 13 in. thick. The snow ice.
0.2	0.5	0.0	0.0	–	1	–	–	From blocks cut and remaining in pond. The clear ice.
								Laurel Lake.
0.0	0.0	0.2	0.0	–	–	247	–	Block 7½ in. thick. Top half.
0.0	0.0	0.0	0.1	–	–	157	–	Bottom half.
								Woods Pond.
0.0	0.1	0.0	0.0	–	–	842	–	Block 6 in. thick. The top half.
0.0	0.0	0.0	0.0	–	–	4	–	Block 6 in. thick. The bottom half.

* On Spicket River. † Area about 10 acres. Swampy shore and muddy bottom.

WATER AND ICE FROM LOWELL.

Chemical Analyses of Water.

[Parts per 100,000.]

Date. Year.	Date. Month.	Date. Day.	Turbidity.	Sediment.	Color.	Residue on Evaporation. Loss on Ignition.	Residue on Evaporation. Fixed Residue.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.
1889	Feb.	28	V. slight.	Slight.	0.0	1.75	3.25	.0686	.0142 .0126	.40	.0600	.0003
1889	Feb.	25	Slight.	V. slight.	0.2	1.15	2.00	.0012	.0124 .0090	.14	.0150	.0001
1889	Feb.	25	Slight.	Sli't, hair-like.	0.2	0.85	2.15	.0022	.0210 .0152	.15	.0090	.0001

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1889	Feb.	28	Slight.	Cons.,eart'y and bla'k.	0.0	1.40 0.45	2.50 0.80	.0184	.0128 .0052	.04	.0060	less than .0001
1889	Feb.	28	None.	Slight.	0.0	0.55 0.50	0.45 0.30	.0036	.0040 .0032	.01	.0050	.0000
1889	Feb.	25	V. slight.	Cons., light floc.&bla'k specks.	0.0	0.85 0.35	0.50 0.30	.0004	.0014 .0000	.00	.0030	.0000
1889	Feb.	25	None.	Cons., both black and light.	0.0	1.12 0.28	3.28 0.52	.0092	.0080 .0040	.05	–	.0001
1889	Feb.	25	V. slight.	Cons., light floc.&bla'k specks.	0.0	0.52 0.36	1.00 0.28	.0000	.0016 .0000	.00	.0030	.0001

WATER AND ICE FROM LYNN.

Chemical Analyses of Water.

[Parts per 100,000.]

Date. Year.	Date. Month.	Date. Day.	Turbidity.	Sediment.	Color.	Residue on Evaporation. Loss on Ignition.	Residue on Evaporation. Fixed Residue.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.
1888	Oct.	10	Slight.	Some, green.	0.2	1.35	4.60	.0254	.0192 .0162	.98	.0250	.0009
1888	Oct.	10	Distinct.	Some, light flocculent.	0.2	1.40	4.70	.0370	.0240 .0160	1.04	.0250	.0011
1889	Feb.	25	Distinct.	Slight.	0.2	2.35	3.20	.0010	.0120 .0104	.72	.0400	.0003

WATER AND ICE FROM LOWELL.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Black Brook.*
0.0	0.4	0.0	pr.	107	Taken from ice field, near outlet of brook.
					Merrimac River.
0.0	0.6	0.0	0.1	277	From Gage's ice field, above dam.
0.0	0.7	0.0	pr.	114	From Gage's ice field, below the dam.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Black Brook.
0.0	0.0	0.0	pr.	-	-	-	39	From ice house. Block 9 in. thick. The snow ice.
0.0	pr.	0.0	0.0	-	3	-	-	From ice house. Remainder of sample.
								Merrimac River.
0.0	pr.	0.0	0.0	-	1	1	-	Freshly cut. From ice field. Block 9 in. thick.
0.0	0.1	0.0	0.0	-	-	-	6	Freshly cut. Block 13 in. thick. Snow ice of sample.
0.0	0.1	0.0	0.0	-	9	-	-	The remainder of sample.

WATER AND ICE FROM LYNN.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Flax Pond.†
0.0	1.1	0.0	pr.	-	Lower end of pond, opposite B. F. Roberts & Son's ice house.
0.0	15.5	0.0	0.4	-	Upper end of pond, opposite Mansfield's ice house.
0.0	35.2	0.0	33.3	12.1	From the cutting in Mansfield's ice field.

* A stream flowing into the Merrimac River, above the dam.

† Area 100 acres. Fed by springs and by brook from Sluice Pond. One mile from centre of Lynn. Receives sewage from two morocco factories.

WATER AND ICE FROM LYNN — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	10	V. slight.	A little, white.	0.0	0.45 0.15	0.65 0.20	.0010	.0018 .0012	.04	.0050	.0001
1888	Oct.	10	V. slight.	Some, white	0.0	0.35 0.15	1.05 0.30	.0038	.0014 .0002	.01	.0070	.0001
1889	Feb.	25	None.	Cons., bla'k and light.	0.0	0.48 0.00	2.00 0.24	.0006	.0018 .0008	.01	.0030	.0000

WATER AND ICE FROM MARLBOROUGH.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	26	Slight.	Slight, light green.	0.0	2.00	3.00	.0006	.0200 .0156	.49	.0200	.0001

Analyses of Ice.

1889	Feb.	26	Clear.	Cons., bl'k & light floc.	0.0	0.75 0.40	1.00 0.15	.0114	.0040 .0022	.02	.0070	.0000
1889	Feb.	26	Clear.	A little, light.	0.0	0.15 0.25	0.25 0.15	.0000	.0012 .0000	.00	.0060	.0000

WATER AND ICE FROM LYNN — Concluded.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Flax Pond.
0.0	0.0	0.0	0.0	3	–	–	–	Ice of 1887-88, from B. F. Roberts & Son's ice house.
0.0	0.0	0.0	0.0	0	–	–	–	Ice of 1887-88, from Mansfield's ice house.
0.0	0.2	0.0	pr.	–	1	2	–	Ice freshly cut from Mansfield's ice field.

WATER AND ICE FROM MARLBOROUGH.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Lake Williams (Gates Pond).*
0.0	37.6	0.0	0.2	4	From the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Lake Williams.
0.0	pr.	0.0	0.0	–	–	–	1	Freshly cut from ice field. Block 12½ in. thick. Snow ice of sample.
0.0	pr.	0.0	0.0	–	0	–	–	Freshly cut from ice field. Remainder of sample.

* Area 125 acres, fed by springs.

WATER AND ICE FROM MAYNARD.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	18	Slight.	Slight, flocculent.	0.3	1.15	2.25	.0000	.0166 .0146	.28	.0050	.0002

Analyses of Ice.

1889	Mar.	18	None.	Cons., bl'k particles.	0.0	–	–	.0080	.0024	.03	–	–
1889	Mar.	18	None.	V. slight.	0.0	0.10 0.00	0.25 0.30	.0000	.0002	.01	.0030	.0000

WATER AND ICE FROM MELROSE.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	25	Distinct.	Con.,e'rthy and leafy.	0.6	2.10	5.90	.0180	.0370 .0224	1.00	.0450	.0012
1889	Feb.	23	Decided.	H'vy,e'rthy and floc't.	0.2	2.05	5.35	.0240	.0202 .0130	.94	.0650	.0009

Analyses of Ice.

1888	Oct.	25	V. slight.	A little, flocculent.	0.0	0.30 0.15	0.55 0.25	.0060	.0020 .0004	.02	.0030	less than .0001
1889	Feb.	23	None.	Heavy, black.	0.0	0.68	2.20	.0020	.0028 .0010	.02	.0050	.0000

WATER AND ICE FROM MAYNARD.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Mill Pond.*
0.0	5.7	0.0	1.5	810	From middle of pond, near Whitney's ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Mill Pond.†
–	–	–	–	–	–	310	–	From F. Whitney's ice house. Ice cut 3 weeks before. Block 10 in. thick. Upper 1½ in. of sample.
0.0	0.0	0.0	0.0	–	37	29	–	From F. Whitney's ice house. The remainder of the sample.

WATER AND ICE FROM MELROSE.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Ell Pond (or Crystal Lake).‡
40.0	120.4	0.0	1.0	Liq.	From the outlet near McIntyre's ice house.
0.2	37.5	0.0	20.3	–	From the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Ell Pond (or Crystal Lake).
0.0	0.0	0.0	0.0	–	6	–	1246	From McIntyre's ice house.
0.0	0.0	0.0	0.0	–	2	–	11	Cut February 22. Block 8½ in. thick. Abundant foreign matter in it.

* Of Assabet Manufacturing Company, on Assabet River.
† Of Assabet Manufacturing Company.
‡ Area 30 acres. Receives drainage from the street and many houses.

WATER AND ICE FROM MELROSE — Concluded.

Analyses of Ice — Concluded.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	17	V. slight.	Considerable.	0.0	0.40	1.00	.0056	.0034 .0008	.02	.0040	.0002
1890	Feb.	17	V. slight.	V. slight.	0.0	–	–	.0004	.0010 .0006	.00	.0040	.0001
1890	Feb.	17	None.	V. slight.	0.0	–	–	.0030	.0026 .0016	.00	.0050	.0002

WATER AND ICE FROM MONSON.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	19	V. slight..	V. slight.	0.15	0.55	1.95	.0002	.0070 .0064	.12	.0070	.0000

Analysis of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1889	Feb.	19	V. slight.	Slight.	0.0	0.20 0.00	0.60 0.30	.0002	.0010 .0008	0.0	.0030	.0000

WATER AND ICE FROM MILLBURY.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	11	Decided.	Heavy, reddish brown.	0.5	3.00 1.60	11.30 8.40	.1680	.0440 .0200	.74	.0150	.0018

WATER AND ICE FROM MELROSE — Concluded.

Analyses of Ice — Concluded.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Ell Pond (or Crystal Lake) — Con.
0.0	0.7	0.2	0.1	–	–	9	-	Ice of 1887–88. Block 13 in. thick. Upper 4 in. of sample.
0.0	0.0	0.0	0.2	–	0	–	–	Ice of 1887–88. Middle 5 in. of sample.
0.0	0.1	0.0	0.0	–	5	–	–	Bottom 4 in. of sample.

WATER AND ICE FROM MONSON.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Factory Pond.*
0.0	0.2	0.0	0.0	164	From the head of the pond.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Factory Pond.
0.0	pr.	0.0	0.0	–	–	20	27	New ice. From blocks remaining after filling ice house. Block 10½ in. thick.

WATER AND ICE FROM MILLBURY.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Blackstone River.†
0.0	0.0	0.0	0.0	3762	

* Area about 5 acres, made by damming Monson Brook.

† Receives the sewage of Worcester.

WATER AND ICE FROM MILLBURY — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	11	Distinct.	Heavy, dirty.	0.0	1.70 0.45	2.90 1.35	.0448	.0306 .0126	.10	.0020	.0003
1890	Feb.	11	Distinct.	Heavy, dirty.	0.0	1.10 0.55	2.15 0.60	.0252	.0176 .0058	.10	.0050	.0003

WATER AND ICE FROM NEEDHAM.

Chemical Analyses of Water.

[Parts per 100,000]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	27	Slight.	Slight.	0.3	1.55	2.85	.0004	.0220 .0168	.44	.0220	.0001
1888	Dec.	13	Distinct.	Slight.	0.2	1.60	3.00	.0028	.0134 .0122	.64	.0500	.0005
1889	Feb.	27	Distinct.	V. slight.	0.3	2.30	3.50	.0000	.0226 .0184	.54	.0200	.0004

Analyses of Ice.

1888	Dec.	13	Clear.	Considerable, white.	0.0	0.25 0.10	0.60 0.50	.0000	.0008 .0000	.01	.0030	.0000
1889	Feb.	27	None.	Slight.	0.0	0.55 0.12	0.65 0.48	.0000	.0020 .0010	.01	.0050	.0000
1888	Dec.	13	Clear.	Considerable, white.	0.0	0.25 0.25	0.45 0.20	.0004	.0014 .0000	.02	.0030	.0000
1889	Feb.	27	V. slight.	Black and leafy.	0.0	0.45 0.28	0.50 0.16	.0002	.0012 .0006	.00	.0060	.0000

WATER AND ICE FROM MILLBURY — Concluded.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Blackstone River.
0.0	0.0	0.0	0.0	–	–	–	1586	Cake 4 in. thick. Upper half. Snow ice.
0.0	0.0	0.0	0.0	–	–	241	–	Cake 4 in. thick. Lower half.

WATER AND ICE FROM NEEDHAM.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					MacIntosh Pond.*
0.0	0.2	0.0	0.2	68	From pond where ice is cut by Needham Ice Co.
					Rosemary Pond.†
–	–	–	–	–	From the ice field of the Rosemary Ice Co.
0.0	0.2	0.0	0.1	59	From the ice field of the Rosemary Ice Co.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								MacIntosh Pond.
–	–	–	–	–	3	5	–	From ice cart of the Needham Ice Co. Ice of 1887–88.
0.0	0.0	0.0	0.0	–	0	5	5	From ice house of the Needham Ice Co. Block 11 in. thick.
								Rosemary Pond.
–	–	–	–	289	–	–	–	From ice house of the Rosemary Ice Co. Ice of 1887–88.
0.0	pr.	0.0	0.0	–	2	76	–	From ice house of the Rosemary Ice Co. Block $8\frac{1}{2}$ in. thick.

* Area 3 acres, made by damming a brook.

† Fed largely by springs, one brook flows into it. In a sparsely settled region. Receives drainage from a few houses.

WATER AND ICE FROM NEWTON (CHESTNUT HILL).

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	22	Distinct, scum at top.	Slight.	1.1	2.00	3.40	.0038	.0450 .0340	.54	.0040	.0003

Analysis of Ice.

1889	Mar.	22	None.	Slight, bl'k particles.	0.0	0.20 0.10	0.55 0.15	.0000	.0012 .0002	.00	.0030	.0000

WATER AND ICE FROM NEWTON.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	15	Distinct.	V. slight.	0.45	1.80	4.70	.0074	.0194 .0160	.61	.1300	.0008

Analysis of Ice.

1889	Mar.	15	None.	Slight, of sticks, etc.	0.0	0.20 0.00	0.55 0.15	.0000	.0012 .0008	.01	.0020	.0000

WATER AND ICE FROM NEWTON (CHESTNUT HILL).

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
0.0	0.1	0.0	5.8	115	**Hammond's Pond.*** From the end of the ice run.

Analysis of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
0.0	0.0	0.0	0.0	–	2	8	–	**Hammond's Pond.** From the ice house. Block 6½ in. thick.

WATER AND ICE FROM NEWTON.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
0.0	0.1	0.0	0.6	638	**Pearl Lake.**† From the pier of Howard's ice house.

Analysis of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
0.0	0.0	0.0	0.0	–	20	–	–	**Pearl Lake.** From ice house of Howard Bros. Block 8 in. thick.

* Fed by springs, has a muddy bottom. No houses or factories near.
† Receives drainage from part of Newton.

WATER AND ICE FROM NORTH ADAMS.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	19	Slight, milky.	A little, light color.	0.0	1.15	13.65	.0010	.0086 .0078	.09	.0100	.0001
1889	Feb.	8	Slight.	Cons., floc. and fibrous.	0.0	0.55	10.85	.0014	.0068 .0042	.08	.0150	.0003
1889	Feb.	8	Slight.	Considerable, light.	0.1	0.80	4.65	.0018	.0174 .0102	.12	.0080	.0000
1890	Feb.	25	Slight.	Slight, earthy.	0.1	1.50	4.10	.0020	.0218 .0180	.14	.0004	.0002

Analyses of Ice.

1888	Oct.	19	Slight.	Con., e'rthy and flocculent.	0.0	0.30 0.10	1.75 1.20	.0014	.0034 .0006	.01	.0020	.0000
1889	Feb.	8	V. slight.	Heavy, dirty and fibrous.	0.0	0.65 0.05	1.65 0.45	.0000	.0062 .0020	.01	.0030	.0001
1889	Feb.	8	None.	Con., he'vy, black and fibrous.	0.0	0.35 0.00	1.10 0.30	.0000	.0046 .0006	.00	.0020	.0001
1890	Feb.	25	None.	Considerable.	0.0	0.36	1.12	.0012	.0018 .0010	.02	.0020	.0001
1890	Feb.	25	None.	Considerable.	0.0	0.16	0.92	.0000	.0004 .0000	.00	.0000	.0000

WATER AND ICE FROM NORTH ANDOVER.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	20	Slight.	Slight, white.	0.1	0.90	2.25	.0004	.0186 .0152	.31	.0030	.0002

WATER AND ICE FROM NORTH ADAMS.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Dean's Pond (or the Cove).*
pr.	3.7	0.0	0.0	–	From the pond.
0.1	0.1	0.0	0.0	2.90	From the ice field.
					Fish Pond (or Reservoir).†
0.0	10.3	0.0	16.4	37	From the ice field.
0.0	124.4	.8	–	–	

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Dean's Pond.
0.0	0.1	0.0	0.0	199	–	–	–	Ice of 1887–88. From ice house of O. B. Titus & Co.
0.3	pr.	0.0	0.0	–	3	9 35	–	Freshly cut from the Titus Co.'s ice field. Block 10 in. thick.
								Fish Pond.
0.0	0.0	0.0	pr.	–	3	2 7	–	Freshly cut from the ice field. Block 14 in. thick. Considerable foreign matter present.
0.0	0.7	0.1	0.0	–	–	121	–	Block 8 in. thick. Top of sample.
0.0	0.5	0.5	0.0	–	–	7	–	Block 8 in. thick. Bottom of sample.

WATER AND ICE FROM NORTH ANDOVER.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Great Pond.‡
0.0	35.5	0.0	0.2	163	From the ice field near outlet of pond.

* Area about 3 acres, made by damming a brook.

† Area about 20 acres. Filled by springs and by pumping from streams below. No mills or houses near.

‡ Area, 645 acres.

WATER AND ICE FROM NORTH ANDOVER — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	20	Clear.	Consid'ble.	0.0	0.00	0.40	.0024	.0040 .0014	.03	.0020	.0002
1889	Feb.	20	None.	Slight, black.	0.0	0.20 0.20	0.35 0.30	.0000	.0010 .0006	.00	.0000	.0000

WATER AND ICE FROM NORTHBRIDGE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	11	Decided.	Heavy, flocculent.	0.3	0.85	4.35	.0600	.0370 .0134	.50	.0200	.0006

Analysis of Ice.

1889	Mar.	11	None.	V. heavy.	0.0	1.65 0.10	0.85 0.20	.0006	.0030 .0010	.01	.0030	less than .0001

ICE FROM NORTHAMPTON.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	13	None.	Slight, black.	0.0	0.40	1.00	.0000	.0006 .0004	.02	.0000	.0001
1890	Feb.	13	None.	V. slight.	0.0	–	–	.0000	.0000	.02	.0020	.0000
1890	Feb.	13	None.	V. slight.	0.0	–	–	.0000	.0004	.01	.0030	.0001

WATER AND ICE FROM NORTH ANDOVER — Concluded.

Analyses of Ice.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Great Pond.
0.0	0.1	0.0	0.0	–	–	8	–	Freshly cut from ice field. Block 9¾ in. thick. The snow ice.
0.0	0.0	0.0	0.0	–	2	–	–	Freshly cut from ice field. The rest of sample.

WATER AND ICE FROM NORTHBRIDGE.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.3	0.0	0.3	74	**Pond fed by Blackstone River.*** Taken about 5 ft. from shore.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.0	0.0	0.0	43	–	–	–	**Pond fed by Blackstone River.** Freshly cut. Block 3¼ in. thick. Contains a little foreign matter.

ICE FROM NORTHAMPTON.

Analyses of Ice.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Norwood Lake (Wright's Pond).
0.0	0.7	0.0	0.1	–	0	–	–	Block 3½ in thick.
								Rocky Hill Ice Pond.
0.0	0.0	0.0	0.0	–	2	–	–	Block 1 ft. thick. The top of block. Ice of 1888–89.
0.0	0.0	0.1	0.0	–	4	–	–	The bottom of block.

* Area about one acre.

WATER AND ICE FROM NORTH WOBURN (MISHAWUM).

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	15	None.	V. slight.	0.0	1.10	7.25	.0014	.0088 .0068	.64	.0250	.0001

Analyses of Ice.

1890	Feb.	15	None.	Slight.	0.0	–	–	.0002	.0002	.00	.0020	.0001
1890	Feb.	15	None.	Slig't, dark particles.	0.0	–	–	.0000	.0000	.00	.0020	.0000

WATER AND ICE FROM PALMER.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrates.
1889	Feb.	19	Slight, milky.	Con., brown and floc't.	0.2	0.85	2.50	.0026	.0144 .0116	.18	.0007	.0002

Analysis of Ice.

1889	Feb.	19	V. slight.	Slight, earthy.	0.0	0.30 0.00	0.50 0.35	.0000	.0014 .0012	.00	.0030	.0001

WATER AND ICE FROM NORTH WOBURN (MISHAWUM).

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Richardson's Pond.
0.0	0.0	pr.	0.0	165	From the hole made in getting the ice.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Richardson's Pond.
0.0	0.0	0.0	0.0	–	3	–	–	Ice of 1890. Block 5 in. thick. Top of block.
0.0	0.0	0.0	0.0	–	–	0	–	Ice of 1890. Bottom of block.

WATER AND ICE FROM PALMER.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Quaboag River.*
0.0	0.4	pr.	0.0	259	From the outlet of the pond.

Analysis of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Quaboag River.
0.0	0.4	pr.	0.0	–	–	4	6	Freshly cut. From E. F. Brainerd's ice house. Block $11\frac{1}{2}$ in. thick.

* Mill Pond at Smith's Mills.

WATER AND ICE FROM PITTSFIELD.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Nov.	13	Distinct, milky.	Con., earthy and floc't.	0.05	4.90	18.35	.0024	.0490 .0440	.37	.1600	.0007
1888	Nov.	13	Slight.	Some, light green.	0.10	2.85	11.50	.0124	.0196 .0156	.37	.0400	.0017
1889	Feb.	12	V. slight.	V. slight.	0.05	2.70	14.15	.0142	.0124 .0074	.46	.1100	.0016
1889	Feb.	12	V. slight.	V. slight.	0.05	2.30	14.95	.0124	.0146 .0068	.44	.1400	.0017
1890	Feb.	25	Slight.	Con., light color'd floc.	0.00	1.35	5.95	.0024	.0118 .0096	.10	.0070	.0001

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1888	Nov.	13	Slight.	Con. light col'd & floc.	0.0	0.65 0.10	2.25 0.70	.0020	.0076 .0012	.01	.0040	less than .0001
1888	Nov.	13	Slight.	A little, lig't colored.	0.0	0.25 0.00	0.95 0.45	.0014	.0044 .0016	.01	.0080	less than .0001
1889	Feb.	12	Clear.	Con., light color'd floc.	0.0	0.45 0.10	2.20 0.85	.0016	.0030 .0014	.02	.0050	.0000
1889	Feb.	12	V. slight.	Heavy, bl'k and slight white.	0.0	0.60 0.05	3.20 1.05	.0018	.0050 .0026	.05	.0030	.0001
1890	Feb.	11	Slight.	Heavy, earthy and dirty.	0.0	0.75	1.40	.0028	.0062 .0022	.02	.0060	.0001
1890	Feb.	11	V. slight.	Con., earthy and dark.	0.0	–	–	.0000	.0012 .0004	.00	.0060	.0001
1890	Feb.	25	V. slight.	V. slight.	0.0	0.24	0.44	.0002	.0006 .0004	.00	.0020	.0001
1890	Feb.	25	V. slight.	Slight, black.	0.0	0.08	0.32	.0002	.0008 .0002	.00	.0000	.0000
1890	Feb.	11	None.	Con., dark.	0.0	0.10	1.25	.0008	.0016 .0010	.00	.0060	.0001
1890	Feb.	11	None.	Slig't, whi'e flocculent.	0.0	–	–	.0000	.0006 .0002	.00	.0020	.0000
1890	Feb.	25	None.	Slight, black.	0.0	0.24	0.56	.0002	.0018 .0006	.01	.0020	less than .0001
1890	Feb.	25	None.	Slight.	0.0	0.12	0.48	.0002	.0002 .0002	.00	.0040	less than .0001

WATER AND ICE FROM PITTSFIELD.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Silver Lake.*
0.0	0.2	0.0	0.0	–	From a brook which enters lake.
5.0	22.2	0.0	2.2	–	From the middle of the lake.
0.0	5.7	0.0	4.6	98	From R. Roberts' ice field.
4.0	1.6	0.0	3.3	85	From F. Gile's ice field.
					Onota Lake.
–	9.4	0.1	8.0	2800	

Analyses of Ice.

				Bacteria in — Transparent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Silver Lake.
0.0	pr.	0.0	0.0	–	–	1836	2968	Ice of 1887–88. From Reed & Burns' ice house.
0.0	0.0	0.0	0.0	–	370	–	–	Ice of 1887–88. From Reed & Burns' ice house.
0.0	pr.	0.0	pr.	–	4	2 6	–	Freshly cut from R. Roberts' ice field. Block 10 in. thick.
0.0	pr.	0.0	0.0	–	0	5 10	–	Freshly cut from F. Gile's ice field. Block 10 in. thick.
0.0	0.0	0.0	0.1	–	–	426	–	Ice of 1888–89. Top of sample.
0.0	0.0	0.0	0.2	–	–	32	–	Ice of 1888–89. Bottom of sample.
								Onota Lake.
0.0	0.0	0.0	0.0	–	–	83	–	Ice of 1890. Cake 8½ in. thick. Top half.
0.0	0.9	0.0	0.0	–	–	36	–	Ice of 1890. Cake 8½ in. thick. Bottom half.
								Lake Pontoosuc.
0.0	0.6	0.2	0.0	–	–	1126	–	Ice of 1890. Block 13 in. thick. Top half.
0.0	0.6	0.0	0.0	–	–	22	–	Ice of 1890. Block 13 in. thick. Bottom half.
0.0	0.8	0.1	0.1	–	–	10	–	Ice of 1890. Block 10 in. thick. Top half.
0.0	0.1	0.1	0.0	–	–	1	–	Ice of 1890. Block 10 in. thick. Bottom half.

* Area about 40 acres. Receives sewage from county jail and neighboring houses.

WATER AND ICE FROM QUINCY.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	29	V. slight.	A little, light.	0.65	1.65	4.00	.0006	.0176 .0150	.84	.0350	.0002
1889	Mar.	9	Slight.	Slight, flocculent.	0.2	1.30	3.45	.0038	.0192 .0144	.67	.0310	.0005

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1888	Oct.	29	V. slight.	Some white and some dark.	0.0	0.30 0.15	0.40 0.25	.0004	.0014 .0008	.01	.0020	.0000
1889	Mar.	9	None.	Con., sticks and black specks.	0.0	0.30 0.00	0,85 0.25	.0000	.0022 .0014	.00	.0020	.0001

WATER AND ICE FROM QUINCY ADAMS.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	9	Slight.	V. slight.	0.5	1.35	3.10	.0004	.0194 .0154	.59	.0200	.0002

Analyses of Ice.

Year.	Month.	Day.	Turbidity.	Sediment.	Color.	Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
1888	Oct.	29	V. slight.	Some white, some dark.	0.0	0.30 0.15	1.40 0.35	.0004	.0018 .0004	.01	.0020	.0001
1889	Mar.	9	None.	Mud, sticks, leaves & bl'k particles.	0.0	0.80 0.05	1.65 0.55	.0002	.0078 .0038	.03	.0030	.0001

WATER AND ICE FROM QUINCY.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Eaton's Pond.*
0.0	2.1	0.0	0.1	–	From the brook which enters pond.
0.0	0.5	0.0	pr.	289	From Eaton's ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Eaton's Pond.
0.0	0.0	0.0	0.0	893	–	–	–	Ice of 1887-88, from Eaton's ice house.
0.5	0.2	0.0	pr.	–	1	3	–	From the ice house, cut one week. Block 7 in. thick.

WATER AND ICE FROM QUINCY ADAMS.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Spears Pond.†
0.0	0.3	0.0	pr.	97	From the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Spears Pond.
0.0	0.0	0.0	0.0	155	–	–	–	Ice of 1887-88.
0.0	9.2	0.0	0.0	–	43	8	–	From the ice house run.

* Area about 3 acres. Made by damming a brook and flowing a meadow.
† A flowed meadow, about 5 acres.

WATER AND ICE FROM READVILLE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albu-minoid.		Nitrates.	Nitrites.
1888	Nov.	20	Distinct, milky.	None.	0.15	1.45	6.25	.0000	.0336 .0276	1.45	.0030	.0000

Analysis of Ice.

1888	Nov.	20	V. slight.	Slight, white.	0.0	0.00 0.05	0.45 0.40	.0000	.0012 .0004	.01	.0040	.0000

WATER AND ICE FROM SHARON.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albu-minoid.		Nitrates.	Nitrites.
1889	Mar.	8	V. slight.	V. slight.	0.2	1.10	1.65	.0012	.0140 .0140	.24	.0550	.0001

Analysis of Ice.

1889	Mar.	8	None.	Consid'ble, black.	0.0	0.00 0.00	0.55 0.40	.0000	.0016 .0009	.01	.0000	.0000

WATER AND ICE FROM READVILLE.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.3	0.0	0.5	124	**Sprague Pond.** From pier of Davenport's ice house.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	pr.	0.0	0.0	–	4	8	–	**Sprague Pond.** Ice of 1887-88. From Davenport's ice house.

WATER AND ICE FROM SHARON.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	12.5	0.0	0.1	51	**Mann's Pond.*** From end of ice run.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	pr.	0.0	0.0	–	2	4	–	**Mann's Pond.** From the ice house. Block 8 in. thick.

* On brook, three-fourths of a mile below Massapoag Lake.

WATER AND ICE FROM SOUTH HADLEY FALLS.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	5	Distinct.	Sli't, brown, flocculent.	0.2	1.10	3.90	.0016	.0124 .0096	.11	.0200	.0001

Analysis of Ice.

1889	Mar.	5	None.	Con., black particles.	0.0	0.52 0.52	0.72 0.28	.0002	.0018 .0010	.01	.0030	–

WATER AND ICE FROM STONEHAM.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Jan.	3	Slight.	Slight, white.	0.20	1.15	3.15	.0000	.0192	.44	.0100	.0000

Analysis of Ice.

1888	Oct.	25	V. slight.	V. slight, fibrous.	0.0	0.20 0.15	0.20 0.20	.0000	.0000 .0000	.00	.0050	.0000

WATER AND ICE FROM SOUTH HADLEY FALLS.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	pr.	0.0	0.0	2016	**Connecticut River.** From east side of river, above dam, where ice was cut.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.1	0.0	0.0	–	3	27	–	**Connecticut River.** Freshly cut from Holyoke Ice Co.'s ice house. Block 9 in. thick.

WATER AND ICE FROM STONEHAM.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
–	–	–	–	–	**Spot Pond.***

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.0	0.0	0.0	0	–	–	–	**Spot Pond.** Ice of 1887-88. From Jones & Carr's ice house.

* Area, 250 acres. In a high location, in a sparsely settled region.

WATER AND ICE FROM TAUNTON.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	1	V. slight.	None.	0.35	1.55	3.05	.0018	.0196	.49	.0060	.0002

Analysis of Ice.

1889	Mar.	1	Clear.	Consid'ble, black.	0.0	0.50 0.70	0.70 0.45	.0002	.0026 .0016	.00	.0200	.0000

WATER AND ICE FROM TURNER'S FALLS.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	7	Decidedly milky.	Consid'ble, grassy, gray and floc'l'nt.	0.1	0.90	3.55	.0014	.0220 .0174	.13	.0180	.0002

Analysis of Ice.

1889	Mar.	7	None.	Con., coarse black.	0.0	0.30 0.10	0.55 0.50	.0000	.0014 .0008	0.0	.0030	.0000

WATER AND ICE FROM TAUNTON.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	pr.	pr.	0.0	96	**Williams Pond.*** From the ice field.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	pr	0.0	0.0	–	3	1	–	**Williams Pond.** Freshly cut. Block 6 in. thick. Contains a good deal of foreign matter.

WATER AND ICE FROM TURNER'S FALLS.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.6	0.0	0.0	1456	**Connecticut River.** From the river where ice was cut.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.0	0.0	0.0	–	1	50	–	**Connecticut River.** Freshly cut from the ice field. Block 12 in. thick.

* Weir Village. Area (in winter) about 12 acres.

WATER AND ICE FROM WAKEFIELD.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	23	Slight.	Slight.	0.6	2.10	5.00	.0000	.0266 .0180	.79	.0280	.0005
1889	Feb.	23	V. slight.	V. slight.	0.1	1.00	2.85	.0026	.0152 .0134	.50	.0180	.0002

Analyses of Ice.

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	23	V. slight.	Much, black.	0.0	0.28 0.08	0.88 0.40	.0000	.0030 .0002	.02	.0030	.0001
1889	Feb.	23	None.	Consid'ble, black.	0.0	0.36 0.16	0.32 0.16	.0000	.0004 .0000	.01	.0050	.0000

WATER AND ICE FROM WALTHAM.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	26	Slight.	Slight, flocculent.	0.5	2.30	2.55	.0008	.0216 .0176	.40	.1100	.0001
1889	Feb.	26	Slight.	V. slight.	0.45	2.25	2.25	.0000	.0194 .0174	.37	.0150	.0001

Analyses of Ice.

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	26	V. slight.	Con., black and light, flocculent.	0.0	0.80 0.50	0.25 0.40	.0004	.0014 .0010	.00	.0030	.0000
1889	Feb.	26	V. slight.	Consid'ble, dirty.	0.0	0.50 0.25	1.35 0.15	.0010	.0026 .0010	.01	.0050	.0000

WATER AND ICE FROM WAKEFIELD.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.0	pr.	6.4	–	**Lake Quanapowitt.*** From ice field of People's Ice Company.
0.0	10.7	0.0	pr.	23	**Crystal Lake.†** From the ice field of the Greenough & Harrington Ice Co.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.0	0.0	pr.	–	1	4	–	**Lake Quanapowitt.** Selected from the ice field. Block 8 in. thick.
0.0	0.3	0.0	pr.	–	0	1	–	**Crystal Lake.** From the ice field. Cut Feb. 22. Block 7 in. thick.

WATER AND ICE FROM WALTHAM.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.4	0.0	2.1	106	**Charles River.** From the ice field above the watch factory and opposite ice house.
0.0	2.3	0.0	0.6	338	From the ice field directly opposite the watch factory and just above bridge.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	pr.	0.0	0.0	–	3	0	3	**Charles River.** From the ice house of C. S. Packard. Block 8½ in. thick.
0.0	8.0	0.0	pr.	–	1	12	–	From the ice house of J. Peterson. Block 7¾ in. thick.

* Area, 250 acres. On its watershed the population is 1,000 to the square mile.

† Area, 50 acres.

WATER AND ICE FROM WATERTOWN.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Nov.	8	Slight.	A little, earthy.	0.45	3.05	7.35	.0066	.0184 .0164	1.12	.1600	.0015
1889	Mar.	15	Slight.	Consid'ble, earthy and flocculent.	0.3	2.75	5.90	.0038	.0164 .0130	.88	.1600	.0009
Analyses of Ice.												
1888	Nov.	8	V. slight.	Some, dark earthy and leafy.	0.0	0.25 0.05	0.70 0.20	.0026	.0018	.00	.0030	.0001
1889	Mar.	15	None.	Cons., sti'ks and black particles.	0.0	–	–	.0000	.0040	.01	.0020	.0000
1889	Mar.	15	None.	V. slight.	0.0	0.20 0.20	0.30 0.30	.0000	.0026 .0008	.01	.0020	.0000

WATER AND ICE FROM WELLESLEY.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	14	V. slight.	V. slight.	0.15	1.35	3.05	.0004	.0162 .0124	.56	.0400	.0002
Analyses of Ice.												
1889	Mar.	14	Slight.	Consid'ble, earthy and fibrous.	0.0	–	–	.0002	.0028	.00	.0020	–
1889	Mar.	14	None.	Consid'ble, earthy and black.	0.0	0.35 0.10	1.45 0.10	.0004	.0040 .0020	.00	.0020	.0000

WATER AND ICE FROM WATERTOWN.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Cook's Pond.*
pr.	1.1	0.0	0.0	–	Opposite ice house of Howard Brothers.
0.0	pr.	0.0	0.0	624	From the pier of Howard's ice house.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Cook's Pond.
0.0	pr.	0.0	0.0	–	10	32	–	From Howard's ice house. Ice of 1887-88.
0.0	1.9	0.0	0.0	169	–	–	–	From shed joining Howard's ice house. Block 12 in. thick. Top of sample.
0.0	0.0	0.0	0.0	–	–	1	–	From shed joining Howard's ice house. Bottom of sample.

WATER AND ICE FROM WELLESLEY.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Longfellow's Pond.†
0.0	1.5	0.0	0.1	314	From the end of ice house pier, Newton Ice Co.

Analyses of Ice.

				Bacteria in — Trans-parent.	Bacteria in — Clear.	Bacteria in — Bubbly.	Bacteria in — Snow ice.	Remarks.
								Longfellow's Pond.
–	–	–	–	21	–	–	–	From ice house of Newton Ice Co. Block 9 in. thick. Top of sample.
0,0	pr.	0.0	0.0	6	–	–	–	From ice house of Newton Ice Co. Remainder of sample.

* A mill pond south of Charles River. † No source of contamination near.

WATER AND ICE FROM WENHAM.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Feb.	21	Decided.	Slight, white.	0.1	1.15	3.25	.0000	.0164 .0138	.70	.0070	.0002

Analysis of Ice.

1889	Feb.	21	Clear.	Consid'ble, earthy and flocculent.	0.0	0.20 0.15	1.05 0.15	.0000	.0014 .0010	.00	.0000	

WATER AND ICE FROM WESTFORD (GRANITEVILLE).

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrates.
1889	Mar.	12	Slight.	None.	0.5	1.10	2.50	.0012	.0186 .0166	.21	.0070	.0002

Analysis of Ice.

1889	Mar.	12	None.	Consid'ble, flocculent.	0.0	0.50 0.00	0.70 0.35	.0046	.0040 .0014	.01	.0030	less than .0001

WATER AND ICE FROM WENHAM.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
5.0	19.9	0.0	8.3	44	**Wenham Lake.*** From Smith's ice field near upper end of lake.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.1	0.0	0.0	–	2	2	–	**Wenham Lake.** Freshly cut from ice field. Block 10 in. thick.

WATER AND ICE FROM WESTFORD (GRANITEVILLE).

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.3	0.0	0.1	–	**Sargent's Pond.** † From under the R. R. bridge.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	0.1	0.0	0.0	–	28	124	–	**Sargent's Pond.** From the ice house. Block 8½ in. thick.

* No evident source of contamination near.
† Made by damming Stony Brook.

WATER AND ICE FROM WEST ROXBURY.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	13	V. slight.	Slight.	0.5	1.10	2.20	.0004	.0210 .0182	.27	.0090	.0001

Analysis of Ice.

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	13	V. slight.	V. slight.	0.0	0.00 0.15	0.35 0.20	.0002	.0014 .0004	.00	.0020	.0001

WATER AND ICE FROM WEST SPRINGFIELD.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	6	Distinct, milky.	Con., e'rthy & floccul'nt.	0.1	1.15	2.50	.0028	.0128 .0080	.15	.0100	.0002

Analysis of Ice.

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	6	V. slight.	Con., black particles.	0.0	0.60 0.32	1.40 0.32	.0000	.0024 .0008	.00	.0070	.0000

WATER AND ICE FROM WEST ROXBURY.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	.9	0.0	0.1	295	**Charles River.*** From the ice field.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
-	-	-	-	147	-	-	-	**Charles River.** From ice house of Winkley Maddox. Block 9 in. thick.

WATER AND ICE FROM WEST SPRINGFIELD.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
0.0	0.8	0.0	0.0	1485	**Agawam River.** Taken half a mile above the Connecticut River.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
0.0	pr.	0.0	0.0	-	-	4 23	-	**Agawam River.** Cut from the river. Block 8 in. thick.

* A wide reach, called Upper Pond.

WATER AND ICE FROM WHITMAN.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	31	Slight.	A little, br'n, flocculent.	1.3	2.30	3.65	.0038	.0304 .0270	.76	.0150	.0003
1889	Mar.	7	Slight.	Slight, earthy.	0.2	1.40	2.90	.0020	.0172 .0142	.62	.0380	.0004

Analyses of Ice.

1888	Oct.	31	Slight.	A little, white, fib's and black.	0.0	0.30 0.10	0.50 0.00	.0004	.0014 .0000	.01	.0030	.0000
1889	Mar.	7	None.	Sl't, fibrous, a little bl'k.	0.0	0.15 0.15	0.30 0.15	.0000	.0014 .0010	.01	.0000	.0001

WATER AND ICE FROM WOBURN.

Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	5	V. slight.	Consid'ble, greenish.	0.2	1.80	10.30	.0178	.0322 .0218	3.29	.0250	.0015
1888	Dec.	6	Slight.	Slight, white.	0.35	2.10	7.05	.0136	.0208 .0158	1.92	.1300	.0011
1889	Feb.	20	Slight, milky.	V. slight.	0.25	1.20	3.75	.0172	.0210 .0162	.67	.0200	.0007
1889	Feb.	25	V. slight.	–	0.3	2.70	7.50	.0064	.0200 .0122	1.50	.1200	.0013

WATER AND ICE FROM WHITMAN.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Hobart's Pond.*
0.0	0.1	0.0	pr.	-	From opposite the ice house of Whitman Ice Co.
0.0	0.2	0.0	0.1	158	From the pier of the ice house.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Hobart's Pond.
0.0	0.8	0.0	0.0	102	-	-	-	Ice of 1887–88. From house of Whitman Ice Co.
0.0	0.0	0.0	0.0	-	1	1	-	From the ice house. Block 7 in. thick.

WATER AND ICE FROM WOBURN.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Horn Pond.
4.1	6.0	4.0	pr.	-	From upper end of pond where ice is cut by Nichols & Carter.
0.0	34.2	0.0	4.0	456	From off pier of Nichols & Carter's ice house.
0.0	pr.	0.0	pr.	327	Collected where sample of ice was taken same day.
0.0	105.5	0.0	15.0	1342	Collected where sample of ice was taken same day.

* Has an area of several acres, and a large population on its water-shed.

WATER AND ICE FROM WOBURN — Concluded.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	5	Clear.	A little lig't and a little heavy bl'ck.	0.0	0.35 0.10	2.45 0.30	.0038	.0056 .0024	.00	.0050	.0001
1888	Dec.	6	V. slight.	V. slight.	0.0	0.25 0.15	0.30 0.25	.0010	.0018 .0006	.01	.0030	.0001
1889	Feb.	20	None.	Slight, bl'k.	0.0	0.25 0.00	0.60 0.50	.0010	.0028 .0008	.02	.0000	.0000
1889	Feb.	25	None.	Slight, with bl'k specks.	0.0	0.65 0.25	1.25 0.55	.0014	.0010 .0008	.01	.0050	.0000

WATER AND ICE FROM WORCESTER.

Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	12	Decided.	Some, eart'y & floc't.	0.3	2.55	7.05	.0158	.0248 .0212	.79	.0800	.0014
1889	Mar.	12	Decided.	Slight.	0.15	2.05	5.95	.0356	.0356 .0220	.70	.0850	.0007
1888	Oct.	12	Slight.	Slight.	0.3	1.30	3.25	.0026	.0154 .0128	.29	.0250	.0004
1889	Mar.	12	V. slight.	None.	0.15	1.00	2.60	.0002	.0134 .0108	.24	.0020	.0002

Analyses of Ice.

1888	Oct.	12	Slight.	Some, earthy and floc't.	0.0	0.20 0.10	0.65 0.20	.0010	.0032 .0014	.00	.0060	.0000
1889	Mar.	12	None.	Considerable.	0.0	–	–	.0046	.0094	.03	–	–
1889	Mar.	12	None.	Considerable.	0.0	0.45 0.00	1.10 0.25	.0006	.0026 .0004	.01	.0060	.0000

WATER AND ICE FROM WOBURN — Concluded.

Analyses of Ice.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Horn Pond.*
0.0	0.0	0.0	0.0	70	–	–	–	Ice of 1887-88. From Nichols and Carter's ice house.
0.0	0.0	0.0	0.0	–	6	949	–	Ice of 1887-88. From Nichols and Carter's new ice house.
0.0	pr.	0.0	0.0	–	3	2	–	Ice of Boston Ice Company. Block 8 in. thick. No foreign matter visible.
0.0	0.3	0.0	0.0	–	0	0	–	Ice of Nichols & Carter's Ice Company. Block 8½ in. thick. Very little foreign matter.

WATER AND ICE FROM WORCESTER.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Crescent Street Pond.†
0.0	3.6	0.0	0.1	–	From outlet of pond.
0.0	0.1	0.0	0.4	1200	From 30 feet above dam, at lower end of pond.
					Salisbury Pond.‡
0.0	0.1	0.0	2.0	–	From off the pier of the Walker Ice Company.
0.0	0.8	pr.	1.6	1258	From off the pier of the Walker Ice Company.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Crescent Street Pond.
0.0	0.0	0.0	pr.	9	–	–	–	Ice of 1887-88. From ice house of A. H. Sears.
–	–	–	–	–	–	58	–	From ice house of A. H. Sears & Co. Block 7 in. thick. The snow ice.
–	–	–	–	–	16	–	–	From ice house of A. H. Sears & Co. Block 7 in. thick. The clear ice.

* Receives much sewage from Woburn and from tanneries.

† A small artificial reservoir near B. & M. R. R. Numerous manufactories and houses near.

‡ Area about 30 acres. Opposite Washburn & Moen's Wire Works. Receives considerable sewage.

WATER AND ICE FROM WORCESTER — Concluded.

Analyses of Ice — Concluded.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1888	Oct.	12	V. slight.	Slight, earthy and floc't.	0.0	0.15 0.05	0.45 0.50	.0000	.0012 .0006	.01	.0050	.0001
1889	Mar.	12	None.	Slight.	0.0	–	–	.0004	.0014	.01	–	–
1889	Mar.	12	None.	V. slight.	0.0	0.05 0.00	0.55 0.25	.0000	.0002 .0002	.00	.0040	.0000
1890	Mar.	14	Slight.	Slight.	0.0	–	–	.0000	.0000 .0000	.00	.0000	.0001
1890	Mar.	14	Slight.	Con., eart'y and floc't, fibrous.	0.0	0.30	0.70	.0000	.0010 .0000	.02	.0020	.0002

WATER AND ICE FROM WRENTHAM, PLAINVILLE.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	11	V. slight.	Slight.	0.1	0.65	2.00	.0002	.0082 .0074	.27	.0070	.0000

Analyses of Ice.

1889	Mar.	11	None.	V. slight.	0.0	0.05	0.30	.0000	.0006 .0004	.01	.0030	.0000
1889	Mar.	11	–	–	–	–	–	.0002	.0008 .0002	–	–	–

WATER AND ICE FROM WORCESTER — Concluded.

Analyses of Ice — Concluded.

Algæ.		Fungi.	Animal Forms.	Bacteria in —				Remarks.
Blue-green.	Others.			Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Salisbury Pond.
–	–	–	–	433	–	–	–	Ice of 1887–88. From ice house of Walker Ice Company.
–	–	–	–	–	–	418	–	From ice house of the Walker Ice Co. Block 11½ in. thick. The bubbly ice.
–	–	–	–	–	12	–	–	From ice house of the Walker Ice Co. Block 11½ in. thick. The remainder of sample.
								North Pond.
0.0	0.0	0.0	0.0	–	–	9	–	Cut a few days previous. Bottom of sample.
0.0	0.0	0.0	0.0	–	–	125	–	Cut a few days previous. Top of sample.

WATER AND ICE FROM WRENTHAM, PLAINVILLE.

Biological Analyses.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Wetherell's Pond.*
0.0	0.5	pr.	0.2	86	From the end of ice run.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Wetherell's Pond.
0.0	0.0	0.0	0.0	–	56	–	–	From the ice house. Block 7½ in. thick.
–	–	–	–	–	–	10	–	From the ice house. Top of block.

* Area about 20 acres. Near head waters of Ten Mile Brook.

WATER AND ICE FROM AUGUSTA, MAINE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	26	Slight.	Sli't, eart'y and floc't.	0.4	1.10	2.35	.0004	.0146 .0134	.07	.0080	.0001

Analysis of Ice.

1889	Mar.	26	None.	None.	0.0	0.12	0.20	.0000	.0006 .0004	.00	.0050	.0001

WATER AND ICE FROM GARDINER, MAINE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	26	Slight.	Con., eart'y and floc't.	0.3	1.30	2.35	.0006	.0142 .0126	.08	.0080	.0001

Analyses of Ice.

1889	Mar.	26	-	-	0.0	-	-	.0068	.0068	-	-	-
1889	Mar.	26	None.	V. slight.	0.0	0.14	0.20	.0000	.0008 .0006	.01	.0040	.0000
1889	Mar.	26	None.	None.	0.0	0.06	0.22	.0000	.0008 .0006	.01	.0040	.0000

WATER AND ICE FROM AUGUSTA, MAINE.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Kennebec River.
0.0	0.2	0.0	0.0	1623	From above the dam.

Analysis of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Kennebec River.
0.0	0.0	0.0	0.0	6	–	–	–	From ice house. Block 17 in. thick.

WATER AND ICE FROM GARDINER, MAINE.

Biological Analysis.

Algæ.		Fungi.	Animal Forms.	Bacteria.	Remarks.
Blue-green.	Others.				
					Kennebec River.
0.0	1.2	0.0	0.0	51	From below the dam.

Analyses of Ice.

				Bacteria in —				Remarks.
				Trans-parent.	Clear.	Bubbly.	Snow ice.	
								Kennebec River.
–	–	–	–	–	–	–	1116	From the ice house. Block 16½ in. thick. The snow ice.
0.0	0.0	0.0	0.0	–	–	9	–	From the ice house. Block 8 in. thick. Slightly bubbly.
0.0	pr.	0.0	0.0	–	7	–	–	From the ice house. Block 8 in. thick. Clear at bottom.

WATER AND ICE FROM CONCORD, NEW HAMPSHIRE.

Chemical Analyses of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	21	Slight, milky.	Slight.	0.15	0.40	2.60	.0000	.0140	.11	.0060	.0000
1889	Mar.	21	Slight, scum on top.	V. slight.	0.20	0.95	2.45	.0014	.0150 .0126	.29	.0090	.0004
1889	Mar.	21	Slight, scum on top.	V. slight.	0.05	0.45	1.85	.0004	.0116 .0098	.10	.0020	.0002

Analyses of Ice.

1889	Mar.	21	None.	Considerable, earthy & black.	0.0	0.45 0.05	0.80 0.20	.0000	.0014 .0008	.00	.0020	.0000
1889	Mar.	21	V. slight.	V. slight.	0.0	0.00 0.05	0.75 0.25	.0000	.0010 .0004	.00	.0030	.0000
1889	Mar.	21	None.	Slight, bl'k & white, fibres.	0.0	0.35 0.05	0.30 0.30	.0000	.0012 .0010	.00	.0030	.0000
1889	Mar.	21	None.	V. slight.	0.0	0.15 0.05	0.30 0.40	.0000	.0010 .0006	.00	.0020	.0000
1889	Mar.	21	V. slight.	V. slight.	0.0	0.00 0.00	0.60 0.60	.0000	.0010 .0006	.00	.0000	.0000
1889	Mar.	21	None.	V. slight.	0.0	0.15 0.25	0.30 0.15	.0030	.0008 .0004	.01	.0000	.0000

ICE FROM LAKE WINNIPISEOGEE.

Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Feb.	27	V. slight.	Considerable, dirty.	0.0	0.60	1.60	.0050	.0034 .0012	.01	.0050	.0001
1890	Feb.	27	None.	V. slight.	0.0	0.28	0.16	.0000	.0008 .0006	.00	.0050	.0000
1890	Feb.	27	None.	V. slight.	0.0	0.24	0.24	.0000	.0000 .0000	.00	.0090	.0000

WATER AND ICE FROM CONCORD, NEW HAMPSHIRE.

Biological Analyses.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Fort Eddy Pond.*
–	–		..	–	From end of ice run.
					Horseshoe Pond.*
0.0	0.3	0.0	0.3	396	From the pond.
					Penacook Lake (or Long Pond).†
0.0	0.2	0.0	3.0	384	From the lake.

Analyses of Ice.

				Bacteria in — Transparent.	Clear.	Bubbly.	Snow ice.	Remarks.
								Fort Eddy Pond.
0.0	0.0	0.0	0.0	–	–	358	–	From Pillsbury & Day's ice house. Block 12½ in. thick. Upper third of sample.
0.0	0.0	0.0	0.0	–	–	56	–	From Pillsbury & Day's ice house. Lower third of sample.
								Horseshoe Pond.
0.0	0.0	0.0	0.0	–	–	320	–	From Randlet & Marsh's ice house. Upper half of sample.
0.0	0.0	0.0	0.0	–	3	–	–	From Randlet & Marsh's ice house. Lower half of sample.
								Penacook Lake (or Long Pond).
0.0	0.0	0.0	0.0	–	–	4	–	From Pillsbury & Day's ice house. Block 12½ in. thick. Upper third of sample.
0.0	0.0	0.0	0.0	–	–	9	–	From Pillsbury & Day's ice house. Lower third of sample.

ICE FROM LAKE WINNIPISEOGEE.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Transparent.	Clear.	Bubbly.	Snow ice.	Remarks.
0.0	0.0	0.1	0.0	–	–	–	2312	Block 19 in. thick. Cut in three pieces. Top 1¾ in. Snow ice.
0.0	0.1	0.0	0.0	–	–	8	–	Middle 8¾ in.
0.0	0.0	0.0	0.0	–	1	–	–	Bottom 8½ in.

* Fed by springs and overflow from Merrimac River. † Three miles from Concord.

WATER AND ICE FROM MILTON, NEW HAMPSHIRE.

Chemical Analysis of Water.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1889	Mar.	19	V. slight.	V. slight.	0.2	0.65	1.75	.0002	.0132 .0112	.10	.0030	.0001

Analyses of Ice.

1889	Mar.	19	None.	V. slight.	0.0	-	-	.0000	.0014	.00	-	-
1889	Mar.	19	None.	Slight.	0.0	0.20 0.00	0.35 0.15	.0000	.0012 .0010	.00	.0030	.0000

ICE FROM RUTLAND, VERMONT.

Chemical Analyses of Ice.

[Parts per 100,000.]

Date.			Turbidity.	Sediment.	Color.	Residue on Evaporation.		Ammonia.		Chlorine.	Nitrogen as	
Year.	Month.	Day.				Loss on Ignition.	Fixed Residue.	Free.	Albuminoid.		Nitrates.	Nitrites.
1890	Mar.	27	None.	Considerable, fibrous & woody.	0.0	0.35	0.95	.0000	.0028 .0004	.004	.0040	.0001
1890	Mar.	27	None.	Considerable, fibrous & woody.	0.0	0.20	0.65	.0000	.0026 .0000	.02	.0030	.0001

WATER AND ICE FROM MILTON, NEW HAMPSHIRE.

Biological Analysis.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria.	Remarks.
					Three Ponds.*
0.0	0.1	0.0	0.1	945	From the ice field.

Analyses of Ice.

				Bacteria in — Trans-parent.	Clear.	Bubbly.	Snow ice.	Remarks.
								Three Ponds.
0.0	0.0	0.0	0.0	–	–	7	–	Freshly cut. Block 10 in. thick. Upper 1½ in. of sample.
0.0	pr.	0.0	0.0	Av'r 2	–	–	–	Freshly cut. Remainder of sample.

ICE FROM RUTLAND, VERMONT.

Analyses of Ice.

Algæ. Blue-green.	Algæ. Others.	Fungi.	Animal Forms.	Bacteria in — Trans-parent.	Clear.	Bubbly.	Snow ice.	Remarks.
0.0	0.3	0.0	0.0	–	–	89	–	Block 4¾ in. thick. Top of sample.
0.0	0.4	0.1	0.0	–	7	–	–	Bottom of sample.

* Area (of pond where ice is cut) about 400 acres.

MORTALITY REPORTS.

A SUMMARY

OF THE

MORTALITY REPORTS OF CITIES AND TOWNS OF MASSACHUSETTS.

The following report comprises the returns of such cities and towns as have forwarded returns of deaths to the State Board of Health weekly during the year 1889. These reports are voluntary, and are received from a portion only of the cities and towns of the State. Nearly all of the cities, many of the large towns and a few of the small towns, send such returns at the close of each week, so that the population represented in the report is mainly an urban population, and consists of about half or a little more than half of the population of the State.

The report may be relied upon as fairly accurate, for the fraction of the population which is concerned in it. It has been published weekly for about twenty years in some one of the daily papers of Boston, and also in the "Boston Medical and Surgical Journal." It is unlike the annual registration report, in that the latter is required by the statutes, and is therefore quite complete in its details, and includes many facts relative to age, residence, sex and nationality, which are not contained in the present report. On the other hand, the mortality reports show a continuous history of the mortality from the principal infectious diseases for a series of years, by months and by weeks, indicating their prevalence at different seasons of the year, and affording a comparison of the mortality at different seasons, with the prevailing meteorological conditions of temperature, rainfall, humidity and barometric pressure.

All estimates of mortality rates must depend for their accuracy upon a census of the population, and for this purpose an estimate must be made in the intervening years between the national and the State census years. This estimate is based upon the rate of increase of population for ten years, from 1875 to 1885; and the probability of error increases as the distance from a census year increases. The population contributing to the returns for 1889 is estimated at 1,110,000.

The data embraced in this report are included in the following table, and comprise the following particulars: they relate to those diseases which are of special sanitary significance, a large portion of which are considered as either infectious, communicable or preventable diseases; to these are also added such meteorological data as are essential.

Average height of barometer for each week.
Mean of daily maximum temperature.
Mean of daily minimum temperature.
Rainfall in inches.
Humidity.
Total deaths reported for each week.
Deaths of children under five years.
Deaths from infectious diseases.
Deaths from consumption.
Deaths from acute lung diseases.
Deaths from typhoid fever.
Deaths from diarrhœal diseases.
Deaths from scarlet-fever.
Deaths from measles.
Deaths from diphtheria and croup.
Deaths from puerperal fever.
Deaths from whooping-cough.
Deaths from malarial fever.
Deaths from small-pox.
Deaths from erysipelas.

General Summary.

DATE.	Barometer.	Maximum Thermometer. Mean for ea. week.	Minimum Thermometer. Mean for ea. week.	Rain — Inches.	Humidity. Mean for ea. week.	Total Deaths.	Deaths under Five Years of Age.	Infectious Diseases.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.	Scarlet-fever.	Measles.	Diphtheria and Croup.	Whooping-cough.	Malarial Fever.	Small-pox.	Erysipelas.	Puerperal Fever.	Death Rate per 1,000.
1889.																					
Jan. 5,	30.13	48	33	2.89	64	387	97	57	62	59	7	9	-	8	30	-	-	-	-	-	20.80
12,	29.81	45	36	.35	75	404	120	41	56	43	6	4	2	2	19	3	-	-	-	-	19.41
19,	30.19	41	27	.38	74	411	127	50	55	67	6	4	3	2	20	4	-	-	-	2	19.49
26,	30.19	32	25	.41	64	411	141	54	62	54	5	5	2	1	29	2	-	-	6	-	19.65
Feb. 2,	29.56	37	24	.54	75	403	110	57	61	54	7	5	5	4	42	5	1	-	3	1	19.32
9,	29.81	36	17	.24	78	483	143	45	63	42	11	8	2	4	13	3	-	-	1	2	19.75
16,	29.95	32	19	.72	72	481	127	56	64	68	5	6	2	4	35	1	-	-	-	-	20.45
23,	30.13	34	24	.02	64	485	146	56	63	72	9	8	-	1	29	3	-	-	2	1	21.31
March 2,	30.59	30	19	.64	73	481	146	48	55	72	9	5	4	4	27	-	-	-	-	-	20.27
9,	29.47	41	33	.02	75	452	196	50	48	69	10	5	4	2	23	2	-	-	1	2	20.11
16,	29.99	44	30	.40	59	464	134	51	71	75	5	4	7	3	19	3	-	-	2	-	20.46
23,	29.93	43	34	.13	74	450	131	41	60	82	5	5	1	3	18	3	-	-	-	1	20.10
30,	29.92	49	32	1.22	58	508	161	65	60	109	9	2	6	5	31	2	1	-	2	-	21.31
April 6,	29.98	42	34	.19	82	355	120	50	46	64	5	5	2	4	29	3	-	-	2	1	20.69
13,	29.92	55	39	.62	60	536	157	49	73	83	9	6	3	-	15	6	-	-	2	1	23.74
20,	30.19	57	41	1.10	69	516	155	65	71	85	7	10	3	3	28	2	-	-	4	2	23.71
27,	80.04	62	44	.03	74	468	141	44	56	66	4	4	1	4	21	2	-	-	3	2	23.83
May 4,	29.77	59	48	.15	73	426	137	57	51	78	8	10	3	2	30	4	-	-	2	-	18.91
11,	29.91	76	49	.09	69	460	146	62	59	72	8	6	2	9	26	4	-	-	-	-	24.41
18,	30.04	74	54	.18	79	487	131	67	55	63	6	10	5	5	30	2	-	-	2	2	21.43
25,	39.89	71	56	3.25	76	426	132	64	66	62	4	12	6	1	27	3	-	-	3	-	19.93
June 1,	30.07	64	50	.67	78	421	116	66	54	53	4	11	9	1	34	4	-	-	1	1	17.11
8,	29.81	70	59	3.26	79	416	132	49	57	39	8	6	-	-	26	3	-	-	-	-	19.01
15,	30.07	82	64	.09	85	402	98	51	54	33	6	9	2	1	25	2	-	-	-	-	19.31
22,	29.91	77	61	.30	77	447	166	90	63	32	7	39	1	5	27	8	-	-	-	-	19.56
29,	30.24	79	61	.11	76	461	170	110	60	32	4	65	-	1	33	4	-	-	-	-	21.24
July 6,	30.13	78	65	.63	84	527	232	162	62	20	7	122	-	-	31	3	-	-	-	-	22.84
13,	29.99	72	63	.04	85	574	324	215	50	18	4	192	1	-	10	4	-	-	1	1	28.42
20,	29.83	77	62	1.72	78	631	334	240	57	30	8	196	-	1	21	10	-	-	-	-	27.52
27,	29.95	74	62	1.95	76	642	324	250	63	20	11	202	1	-	22	8	-	-	-	-	27.16

Aug. 3,	30.07	80	67	3.20	88	625	316	215	60	63	14	146	3	-	25	3	-	-	1	-	28.70
10,	30.08	75	61	.34	77	584	259	192	79	16	7	154	2	2	14	9	-	-	-	-	26.41
17,	29.97	71	58	1.48	76	586	279	206	52	22	17	150	1	-	24	11	1	-	-	-	25.00
24,	30.00	77	63	.39	75	599	242	182	57	26	20	120	1	2	26	6	-	-	-	-	27.19
31,	30.25	69	57	-	81	523	227	144	43	23	19	95	1	-	26	6	2	-	-	1	23.49
Sept. 7,	30.20	78	62	.01	-	578	250	172	69	32	20	112	1	2	26	5	-	-	-	-	24.91
14,	30.21	66	59	1.14	91	484	228	137	43	21	17	87	1	1	26	1	-	-	-	-	21.79
21,	29.81	69	59	1.87	84	471	199	124	63	15	18	73	2	-	25	4	-	-	-	-	21.50
28,	30.01	63	49	.17	73	447	177	118	49	34	19	56	1	1	26	6	-	-	-	-	19.88
Oct. 5,	30.01	64	48	.33	73	502	189	119	60	17	28	51	1	-	32	4	-	-	-	-	23.14
12,	29.93	56	43	.63	73	475	166	74	49	51	12	27	-	-	25	3	-	-	-	-	21.62
19,	30.08	53	40	1.96	73	414	107	62	68	30	9	16	-	-	30	3	-	-	-	-	19.60
26,	30.21	51	39	.05	71	476	150	100	60	51	16	23	3	1	50	4	-	-	-	-	20.51
Nov. 2,	30.06	51	45	1.09	84	424	120	72	74	46	18	13	2	-	36	1	-	-	-	-	20.24
9,	30.81	54	42	.40	67	437	125	63	66	54	14	7	1	-	33	6	-	-	-	-	19.17
16,	30.09	49	38	1.11	79	406	120	45	54	51	8	8	1	-	24	1	1	-	-	-	17.78
23,	29.90	50	39	1.70	77	368	111	57	49	44	15	7	5	-	25	2	-	1	1	-	17.56
30,	30.14	46	34	1.70	71	383	107	52	59	51	10	7	1	-	31	-	-	-	-	-	17.20
Dec. 7,	30.17	40	24	.13	62	406	116	62	73	55	13	4	4	-	29	4	-	-	-	-	19.01
14,	30.11	48	36	.67	72	405	110	62	43	51	5	7	1	-	38	-	-	-	1	-	17.50
21,	30.23	44	32	.44	79	400	108	56	44	46	8	2	3	-	14	5	-	-	-	-	20.11
28,	29.53	47	33	.55	60	522	149	60	75	86	6	12	1	-	41	3	-	-	1	-	23.74
Total,	-	-	-	-	-	24,530	8,549	4,736	3,066	2,601	514	2,152	113	89	1,396	190	6	1	41	20	-
Weekly average,	-	-	-	-	-	472	164	91	59	50	10	41	2	2	25	4	-	-	1	-	-
Ratio per 1,000 deaths,	-	-	-	-	-	-	348.5	193.07	124.98	106.03	20.9	87.73	4.6	3.62	56.91	7.74	-	-	1.67	.82	-

Estimated average reporting population, ... 1,110,000

Total Deaths.

The whole number of deaths reported for the year 1889, from those cities and towns which contributed to the returns, was 24,530, and the average number for each week was 472. The greatest number of deaths reported in a single week was 642, in the week ending July 27; and the least number reported was 355, in the week ending April 6. The greatest number reported in 1888 was in the week ending August 4, and the least number in the week ending July 14. The weekly average number reported in each month was as follows: —

January,	403	July,	594
February,	463	August,	583
March,	471	September,	495
April,	469	October,	465
May,	449	November,	403
June,	429	December,	434

The months in which the greatest number of deaths was reported were July, August and September, and those in which the least number was reported were January, June and November. The percentages of mortality in each quarter of the year were as follows: —

	All Ages.		Ages under Five Years.	
	Numbers.	Percentages.	Numbers.	Percentages.
First quarter,	5,820	23.73	1,779	20.81
Second quarter,	5,821	23.73	1,701	19.90
Third quarter,	7,271	29.64	3,391	39.67
Fourth quarter,	5,618	22.90	1,678	19.62
Totals,	24,530	100.00	8,549	100.00

The ratios of the total deaths in each of the first two quarters of the year were nearly identical, and each was slightly greater than the mortality of the last quarter; while that of the third quarter was, as usual, much in excess of either of the remaining quarters.

Deaths under Five Years.

The number of deaths reported of children under five years of age was 8,549, and the weekly average for the year was 164. The greatest number of deaths of this class reported for a single week was 334, for the week ending July 20; and the least number was 97, for the week ending January 5. The ratio of reported deaths of children under five years of age to the total deaths was 34.85 per cent., or one in 2.8, which was greater than that of 1888 (33.69), and less than that of 1887 (36.6). The average weekly number of deaths of children under five for each month was as follows: —

January,	121	July,	303
February,	131	August,	265
March,	153	September,	213
April,	143	October,	153
May,	136	November,	116
June,	116	December,	121

The months in which the greatest number of deaths under five years was reported were July, August and September, and those in which the least number was reported were June, November, December and January.

Consumption.

The number of deaths reported from consumption during the year was 3,066, and the weekly average 59. The average weekly number of deaths from this cause for each month was as follows: —

January,	59	July,	58
February,	63	August,	58
March,	59	September,	56
April,	61	October,	59
May,	58	November,	60
June,	57	December,	59

The months having the least number of reported cases of consumption were June and September, and those having the greatest number were February, April and November.

There was a variation of only 7 between the maximum and minimum weekly average. The ratio of reported deaths from consumption to the total reported mortality from all causes was 125 per 1,000, as compared with 134.2 in 1888, 141.1 in 1887, and 156.5 in 1886. This steady decrease in the mortality from this disease, as compared with the total mortality, agrees quite closely with the figures of the registration reports of those years for the whole population, which were as follows: 1886, 158.3; 1887, 144.0; 1888, 136.1. The least number of deaths reported in any week from this cause was 43, during the week ending December 14; and the greatest number 75, in the week ending December 28. It was in this last week of the year that the mortality from epidemic influenza began to manifest itself, since the deaths from consumption, as well as those from the whole class of diseases of the respiratory organs, was increased during this period.

Acute Lung Diseases (*Pneumonia, Bronchitis, Asthma and Pleurisy*).

The number of deaths reported from this group of diseases was 2,601, and the average number for each week was 50. The average weekly number reported for each month was as follows: —

January,	56	July,	22
February,	59	August,	37
March,	81	September,	25
April,	75	October,	37
May,	69	November,	49
June,	37	December,	59

The months having the greatest number of reported deaths from these causes were March, April and May, and those having the least number were July, August and September. The ratio of deaths from these causes, as compared with the total mortality, was 106.03 per 1,000, as compared with 121.8 in 1888, 107.3 in 1887, and 102.4 in 1886. The greatest number of deaths reported from these causes in any week was 109, in the week ending March 30; and the least number was 15, in the week ending September 21.

Typhoid Fever.

The number of deaths reported from typhoid fever in 1889 was 514, and the weekly average 10. The average weekly number reported for each month was as follows: —

January,	6	July,	7
February,	8	August,	15
March,	7	September,	18
April,	5	October,	16
May,	6	November,	13
June,	6	December,	8

The greatest number of reported deaths from this disease occurred in the months of August, September, October and November, and the least number in January, April and May. The ratio of reported deaths from this cause to the total mortality was 20.9 per 1,000, as compared with 20.7 in 1888, 20.9 in 1887, and 18.4 in 1886. The average annual mortality rate per 1,000 from this cause for the decade 1861–70 was 46.9, and for the next decade it was 31.7, as shown in the registration reports. The greatest number of deaths reported from this cause in any one week was 28, in the week ending October 5; and the least number was 4, in each one of the four weeks ending April 27, May 25, June 1 and June 29.

Diarrhœal Diseases (*Diarrhœa, Dysentery, Cholera Infantum, Cholera and Enteritis*).

The number of deaths reported from these causes in 1889 was 2,152, and the weekly average was 41. The average weekly number reported for each month was as follows: —

January,	5	July,	178
February,	7	August,	133
March,	4	September,	82
April,	6	October,	29
May,	9	November,	8
June,	26	December,	6

The months having the greatest number of reported deaths were July, August and September, and those having the least number were January, March and April. The

mortality from these diseases reported in the last two quarters of 1889 was 87.8 per cent. of the whole number reported for the year from the same causes; and for the three months, July, August and September, it was 79.2 per cent. The ratio of the mortality from these causes to the total mortality was 87.7 per 1,000, as compared with 77.9 in 1888, 82.5 in 1887, and 77.2 in 1886. The greatest number of deaths reported in any one week from these causes was 202, in the week ending July 27; and the least number was 2, in the weeks ending March 30 and December 21.

Scarlet-fever.

The total number of reported deaths from scarlet-fever in 1889 was 113, and the average weekly mortality from the same cause as reported was 2. The average weekly mortality as reported for each month was as follows: —

January,	2	July,	1
February,	2	August,	2
March,	4	September,	1
April,	2	October,	1
May,	4	November,	2
June,	2	December,	2

The months having the greatest reported mortality from this cause were March and May, and those having the least were July, September and October. The ratio of mortality from scarlet-fever to the total mortality was 4.6 per 1,000, as compared with 11.2 in 1888, 14.4 in 1887, and 8.7 in 1886. This was the lowest mortality from scarlet-fever for many years. The ratio for the thirty years ending with 1888 was 28.9 per 1,000, and the lowest ratio of any year in that period was 8.7; while that of 1889, as estimated from the reported returns, was but little more than half as large. The actual number of deaths from this cause in 1872, '73, '74, '75 and '76, were 1,377, 1,472, 1,382, 1,684 and 1,222. The greatest reported number of deaths from this cause in any one week was 9, in the week ending June 1. There were no reported deaths from scarlet-fever in the weeks ending January 1, February 23, June 8 and 29, July 6 and 20, October 12 and 19.

Measles.

The whole number of deaths from this cause reported for 1889 was 89, and the average weekly mortality 2. The average weekly mortality from this cause for each week was as follows: —

January,	3	July,	–
February,	3	August,	1
March,	3	September,	1
April,	3	October,	–
May,	4	November,	–
June,	2	December,	–

The months having the greatest number reported were March and May. There were no deaths from measles in November and December. The ratio of mortality from this cause to the total mortality was 3.6 per 1,000, as compared with 2.8 per 1,000 in 1888.

Diphtheria and Croup.

The total number of deaths reported from diphtheria and croup in 1889 in the reporting cities and towns was 1,396, and the average number for each week was 27. The average weekly number reported in each month was as follows: —

January,	24	July,	21
February,	30	August,	23
March,	23	September,	26
April,	23	October,	34
May,	28	November,	29
June,	29	December,	30

The months in which the greatest number of deaths was reported from these causes were June, October and November, and those in which the least number were reported were April and July. The ratio of the reported mortality from these causes to the total reported mortality was 56.9 per 1,000, which was greater than that of either of the four preceding years, 1885, 1886, 1887 and 1888.

Whooping-cough, Erysipelas, Puerperal Fever, Malarial Fever and Small-pox.

The total number of deaths from these causes reported in 1889 was as follows: —

	Total Deaths Reported.	Weekly Average.	Ratio per 1,000 Reported Deaths from All Causes.
Whooping-cough, ...	190	3.7	7.7
Erysipelas, ...	41	0.8	1.7
Puerperal fever, ...	20	0.4	0.8
Malarial fever, ...	6	0.11	0.4
Small-pox, ...	–	–	–

The reported mortality from whooping-cough was greater than that of either of the three preceding years. That from erysipelas was scarcely half as great as that of 1888, and was also less than that of 1886 and 1887.

The number of deaths reported from puerperal fever was only 20. The reported mortality from this disease has diminished with considerable uniformity from 127 in 1883. The reported deaths in the successive years were 127, 103, 72, 39, 43, 35, 20.

Mortality of Cities.

The following tables present the deaths for each of the principal cities of the State, as obtained from the postal cards which are received each week at the office of the State Board of Health. It has been the custom in census years and in those years immediately following the census years to present these data in the form of ratios to the living population. The liability to error, however, which attends all estimates of population, increases as the distance in time from an accurate census of the population increases; hence the number of deaths in each week is given without the ratios.

Mortality of Cities.

1889. Week ending—	Boston.	Worcester.	Lowell.	1889. Week ending—	Boston.	Worcester.	Lowell.
Jan. 5, .	177	22	29	July 6, .	189	37	45
12, .	180	29	37	13, .	238	33	44
19, .	185	31	32	20, .	251	46	49
26, .	198	23	27	27, .	238	37	42
Feb. 2, .	188	23	36	Aug. 3, .	238	36	44
9, .	182	29	32	10, .	218	42	36
16, .	185	28	40	17, .	203	29	47
23, .	195	32	25	24, .	235	29	50
March 2, .	197	29	29	31, .	218	29	39
9, .	178	31	36	Sept. 7, .	227	33	51
16, .	198	20	22	14, .	204	20	32
23, .	182	29	25	21, .	184	23	43
30, .	200	41	32	28, .	175	29	46
April 6, .	199	19	33	Oct. 5, .	189	29	42
13, .	248	25	30	12, .	205	25	35
20, .	231	27	40	19, .	175	22	22
27, .	219	23	61	26, .	180	19	40
May 4, .	193	26	34	Nov. 2, .	172	15	27
11, .	188	27	39	9, .	177	27	26
18, .	218	16	31	16, .	148	24	28
25, .	189	21	34	23, .	168	21	32
June 1, .	164	27	25	30, .	152	19	23
8, .	188	20	26	Dec. 7, .	153	29	39
15, .	174	19	43	14, .	153	22	42
22, .	158	22	41	21, .	193	22	32
29, .	185	21	44	28, .	232	26	42

Mortality of Cities — Continued.

1889. Week ending —	Cambridge.	Fall River.	Lynn.	1889. Week ending —	Cambridge.	Fall River.	Lynn.
Jan. 5, .	23	32	23	July 6, .	34	32	16
12, .	16	30	13	13, .	39	44	14
19, .	22	25	16	20, .	28	44	13
26, .	19	30	10	27, .	32	31	21
Feb. 2, .	17	25	9	Aug 3, .	32	46	23
9, .	17	22	25	10, .	40	49	21
16, .	22	32	13	17, .	32	44	28
23, .	23	26	23	24, .	25	41	18
March 2, .	15	26	23	31, .	23	29	19
9, .	18	28	15	Sept. 7, .	21	41	15
16, .	18	34	21	14, .	28	35	17
23, .	28	30	16	21, .	25	29	23
30, .	25	23	17	28, .	14	28	15
April 6, .	23	19	17	Oct. 5, .	31	47	19
13, .	33	33	22	12, .	29	30	11
20, .	26	31	11	19, .	25	25	19
27, .	22	21	18	26, .	20	15	19
May 4, .	16	27	19	Nov. 2, .	28	29	13
11, .	27	20	15	9, .	21	19	11
18, .	25	20	27	16, .	25	22	14
25, .	26	25	19	23, .	22	14	12
June 1, .	19	22	15	30, .	32	22	14
8, .	17	18	11	Dec. 7, .	22	30	18
15, .	25	13	14	14, .	19	16	12
22, .	27	26	9	21, .	29	18	8
29, .	20	23	20	28, .	24	32	13

Mortality of Cities — Continued.

1889. Week ending —	Springfield.	Lawrence.	New Bedford.	1889. Week ending —	Springfield.	Lawrence.	New Bedford.
Jan. 5, .	18	12	11	July 6, .	23	25	12
12, .	13	13	7	13, .	20	42	23
19, .	17	18	10	20, .	25	18	22
26, .	12	13	13	27, .	26	38	28
Feb. 2, .	13	22	13	Aug. 3, .	13	26	27
9, .	9	20	8	10, .	13	24	18
16, .	12	11	10	17, .	19	33	20
23, .	13	15	15	24, .	8	28	23
March 2, .	12	20	12	31, .	21	27	16
9, .	26	13	6	Sept. 7, .	17	27	16
16, .	19	16	13	14, .	16	16	29
23, .	12	15	8	21, .	17	22	17
30, .	12	14	15	28, .	6	20	15
April 6, .	18	10	13	Oct. 5, .	10	34	7
13, .	14	13	21	12, .	11	21	17
20, .	22	19	18	19, .	13	20	16
27, .	20	12	15	26, .	10	32	13
May 4, .	13	20	10	Nov. 2, .	18	28	19
11, .	21	16	16	9, .	5	24	11
18, .	16	16	10	16, .	21	16	12
25, .	13	17	14	23, .	11	18	13
June 1, .	8	23	10	30, .	6	25	13
8, .	12	18	11	Dec. 7, .	14	14	13
15, .	13	18	9	14, .	13	19	9
22, .	19	18	20	21, .	3	22	9
29, .	13	26	9	28, .	16	21	18

Mortality of Cities — Continued.

1889. Week ending —	Brockton.	Chelsea.	Haverhill.	1889. Week ending —	Brockton.	Chelsea.	Haverhill.
Jan. 5, .	6	6	11	July 6, .	8	16	11
12, .	7	16	5	13, .	6	24	8
19, .	5	9	6	20, .	6	14	10
26, .	3	7	5	27, .	8	16	11
Feb. 2, .	5	15	8	Aug. 3, .	12	17	8
9, .	8	8	4	10, .	6	12	12
16, .	9	4	3	17, .	8	11	10
23, .	4	11	7	24, .	9	14	16
March 2, .	14	6	5	31, .	6	8	14
9, .	8	10	8	Sept. 7, .	6	5	9
16, .	9	11	3	14, .	7	11	4
23, .	7	7	7	21, .	6	13	7
30, .	10	8	10	28, .	9	10	8
April 6, .	7	11	4	Oct. 5, .	3	9	8
13, .	9	10	6	12, .	7	7	8
20, .	9	8	5	19, .	3	4	10
27, .	6	7	9	26, .	13	12	10
May 4, .	6	8	6	Nov. 2, .	15	5	7
11, .	9	16	9	9, .	9	8	11
18, .	4	8	7	16, .	8	14	5
25, .	7	8	6	23, .	5	10	4
June 1, .	9	7	8	30, .	6	12	12
8, .	6	12	7	Dec. 7, .	4	7	4
15, .	4	9	10	14, .	7	6	9
22, .	8	13	6	21, .	10	9	7
29, .	10	9	13	28, .	5	9	12

Mortality of Cities — Continued.

1889. Week ending —	Taunton.	Gloucester.	Newton.	1889. Week ending —	Taunton.	Gloucester.	Newton.
Jan. 5, .	8	3	6	July 6, .	7	2	8
12, .	5	4	2	13, .	5	4	6
19, .	7	11	4	20, .	14	6	7
26, .	4	6	9	27, .	16	8	4
Feb. 2, .	8	5	8	Aug. 3, .	18	4	6
9, .	7	2	8	10, .	17	5	8
16, .	8	3	11	17, .	8	6	11
23, .	14	5	11	24, .	16	8	5
March 2, .	7	3	5	31, .	10	12	5
9, .	5	4	7	Sept. 7, .	12	7	2
16, .	8	9	3	14, .	12	5	6
23, .	11	4	3	21, .	9	2	6
30, .	5	4	9	28, .	5	3	8
April 6, .	7	2	4	Oct. 5, .	12	11	4
13, .	9	5	3	12, .	8	9	8
20, .	6	1	6	19, .	10	1	5
27, .	10	6	5	26, .	13	4	5
May 4, .	7	5	2	Nov. 2, .	7	8	6
11, .	5	5	5	9, .	5	7	9
18, .	20	10	4	16, .	6	5	6
25, .	7	3	7	23, .	9	5	4
June 1, .	9	3	3	30, .	9	11	5
8, .	7	7	9	Dec. 7, .	5	8	7
15, .	7	6	12	14, .	7	1	3
22, .	6	4	6	21, .	8	8	4
29, .	5	7	5	28, .	15	4	7

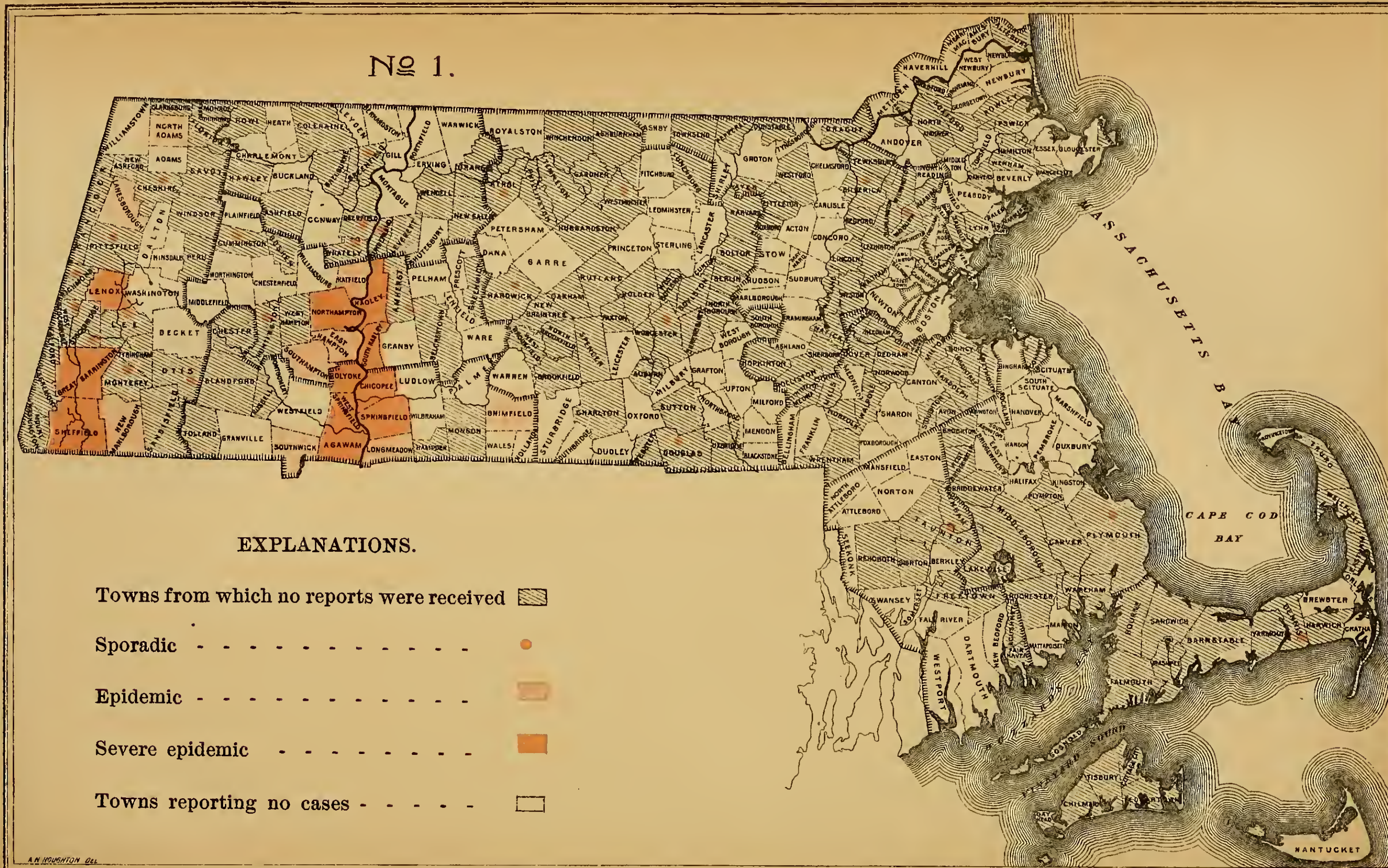
Mortality of Cities — Continued.

1889. Week ending —	Malden.	Fitchburg.	Waltham.	1889. Week ending —	Malden.	Fitchburg.	Waltham.
Jan. 5, .	7	5	6	July 6, .	6	8	3
12, .	3	3	7	13, .	7	6	2
19, .	5	4	5	20, .	9	7	3
26, .	4	4	5	27, .	11	4	6
Feb. 2, .	6	2	2	Aug. 3, .	8	7	9
9, .	4	3	1	10, .	7	7	3
16, .	8	5	8	17, .	13	5	2
23, .	10	3	7	24, .	9	10	5
March 2, .	10	2	6	31, .	5	6	10
9, .	5	3	3	Sept. 7, .	13	9	10
16, .	14	3	4	14, .	6	7	3
23, .	9	3	5	21, .	6	4	10
30, .	4	7	10	28, .	5	3	5
April 6, .	1	4	7	Oct. 5, .	4	4	5
13, .	7	6	4	12, .	8	5	8
20, .	14	6	5	19, .	6	8	9
27, .	5	–	8	26, .	9	9	10
May 4, .	2	7	5	Nov. 2, .	7	6	4
11, .	4	10	6	9, .	8	7	9
18, .	10	3	3	16, .	2	6	5
25, .	5	5	6	23, .	6	5	3
June 1, .	4	4	7	30, .	3	2	4
8, .	7	7	8	Dec. 7, .	2	9	2
15, .	7	3	7	14, .	5	6	2
22, .	8	8	1	21, .	5	5	7
29. .	10	8	8	28, .	11	7	1

Mortality of Cities — Concluded.

1889. Week ending —	Newburyport.	Salem.	Quincy.	1889. Week ending —	Newburyport.	Salem.	Quincy.
Jan 5, .	8	10	3	July 6, .	1	16	4
12, .	2	10	3	13, .	3	20	5
19, .	4	10	3	20, .	9	16	9
26, .	9	16	3	27, .	4	23	6
Feb. 2, .	3	11	8	Aug 3, .	13	23	7
9, .	8	12	3	10, .	5	19	6
16, .	7	13	7	17, .	11	14	6
23, .	10	16	1	24, .	9	16	8
March 2, .	8	11	1	31, .	4	13	4
9, .	7	10	1	Sept. 7, .	6	16	6
16, .	2	9	7	14, .	4	6	9
23, .	3	14	6	21, .	3	14	3
30, .	5	11	6	28, .	3	14	5
April 6, .	5	10	6	Oct. 5, .	9	9	3
13, .	5	7	2	12, .	6	13	7
20, .	4	6	7	19, .	8	13	8
27, .	5	10	6	26, .	3	9	4
May 4, .	6	8	1	Nov. 2, .	4	17	8
11, .	9	6	7	9, .	8	11	4
18, .	8	15	8	16, .	4	16	7
25, .	6	4	5	23, .	1	14	2
June 1, .	5	16	11	30, .	1	6	3
8, .	6	12	3	Dec. 7, .	8	12	8
15, .	4	12	5	14, .	6	14	5
22, .	2	8	9	21, .	3	13	3
29, .	4	10	6	28, .	5	9	5

INTERMITTENT FEVER IN MASSACHUSETTS.



INTERMITTENT FEVER IN MASSACHUSETTS BEFORE 1880.

INTERMITTENT FEVER IN MASSACHUSETTS SINCE 1880.

INTERMITTENT FEVER IN MASSACHUSETTS.

By Dr. C. H. Cook of Natick.

Intermittent fever in Massachusetts has reached its third stage. The first stage was one of skepticism, when no one, save those who were brought in contact with the disease, believed it to be indigenous as an epidemic in any part of the State; and, at the very first, even physicians who were having professional experience with it might properly have questioned their own conclusions as to its origin. The second stage was one of surprise that it should appear in *our* city or town, which heretofore had been supposed to be free from conditions favorable to its development. The third and present stage is one of questioning and expectation; questioning as to whether it be a visitor, or has come to stay, and expectation that it will appear in localities not yet invaded.

Dr. Oliver Wendell Holmes, in his "Boylston Prize Essay," gives a full and complete history of intermittent fever in this State, and also the other New England States, up to 1836, the year of publication. Dr. J. F. Alleyne Adams of Pittsfield, in a paper published in the report of the State Board of Health, Lunacy and Charity for 1880, after giving a brief summary of Dr. Holmes' essay, continues to that year the history for Massachusetts. It is the object of the present paper to continue the record to the close of the year 1889.

To obtain the necessary information, over eight hundred circulars of inquiry were sent in December, 1889, to physicians in all parts of the State. For the purpose of securing as reliable answers as possible, the inquiries were limited to intermittent fever only, no attention being paid either to remittent fever or to "malaria." Replies have been received from three hundred and six physicians, representing one hundred and fifty-two cities and towns. These replies discover intermittent fever in eighty-six cities and towns, an increase of thirty-nine over the number reported in 1880 by

Dr. Adams.* Of these eighty-six cities and towns, thirty-four report only sporadic cases, as follows: Belmont, Boston, Braintree, Brockton, Brookline, Chilmark, Fall River, Fitchburg, Foxborough, Hingham, Hinsdale, Hudson, Leominster, Lexington, Malden, Marlborough, Maynard, Medford, Milton, New Bedford, Norfolk, Quincy, Rockland, Somerville, Spencer, Taunton, Upton, Walpole, Westborough, Whitman, Winchester, Woburn, Worcester, Wrentham. The remaining fifty-two, which report the disease as more or less epidemic, are: Agawam, Amherst, Arlington, Ashland, Attleborough, Bellingham, Blandford, Cambridge, Chicopee, Concord, Dedham, Dighton, Dover, Easthampton, Framingham, Grafton, Greenfield, Hadley, Holliston, Hopedale, Hopkinton, Holyoke, Hyde Park, Ludlow, Mansfield, Medway, Milford, Millbury, Millis, Monson, Montague, Natick, Needham, Newton, Northampton, Russell, Sharon, Sheffield, Sherborn, Springfield, South Hadley, Sudbury, Swanzey, Waltham, Warren, Watertown, Wayland, Wellesley, Weston, West Springfield, Wilbraham, Williamsburg.

The following tabular arrangement by counties, for more convenient reference, gives the names of cities and towns reporting cases, those reporting no cases, and the number not heard from: —

BARNSTABLE COUNTY.

No cases: —
Chatham,
Harwich, — 2.
No. of towns not heard from, 12.

BERKSHIRE COUNTY.

Cases: —
Hinsdale,
Sheffield, — 2.
No cases: —
Cheshire,
Dalton,
North Adams,
Pittsfield,
Williamstown, — 5.
No. of towns not heard from, 25.

BRISTOL COUNTY.

Cases: —
Attleborough,
Dighton,
Fall River,
Mansfield,
New Bedford,
Swanzey,
Taunton, — 7.
No. of towns not heard from, 12.

DUKES COUNTY.

Cases: —
Chilmark, — 1.
No cases: —
Tisbury, — 1.
No. of towns not heard from, 3.

* Dr. Adams reported forty-eight cities and towns, but in one of them (Amesbury) the form was remittent, which leaves forty-seven as the number for present comparison.

ESSEX COUNTY.

No cases: —
- Danvers,
- Gloucester,
- Lynn,
- Methuen,
- Newburyport,
- West Newbury, — 6.

No. of towns not heard from, 29.

FRANKLIN COUNTY.

Cases :—
- Greenfield,
- Montague, — 2.

No cases: —
- Ashfield,
- Bernardstown,
- Conway,
- Orange,
- Shelburne, — 5.

No. of towns not heard from, 19.

HAMPDEN COUNTY.

Cases: —
- Agawam,
- Blandford,
- Chicopee,
- Holyoke,
- Ludlow,
- Monson,
- Russell,
- Springfield,
- West Springfield,
- Wilbraham, — 10.

No. of towns not heard from, 12.

HAMPSHIRE COUNTY.

Cases: —
- Amherst,
- Easthampton,
- Hadley,
- Northampton,
- South Hadley,
- Williamsburg, — 6.

No cases: —
- Huntington,
- Ware, — 2.

No. of towns not heard from, 15.

MIDDLESEX COUNTY.

Cases: —
- Arlington,

MIDDLESEX COUNTY — Con.

- Ashland,
- Belmont,
- Cambridge,
- Concord,
- Framingham,
- Holliston,
- Hopkinton,
- Hudson,
- Lexington,
- Malden,
- Marlborough,
- Maynard,
- Medford,
- Natick,
- Newton,
- Sherborn,
- Somerville,
- Sudbury,
- Waltham,
- Watertown,
- Wayland,
- Weston,
- Winchester,
- Woburn, — 25.

No cases: —
- Acton,
- Ashby,
- Ayer,
- Bedford,
- Billerica,
- Carlisle,
- Chelmsford,
- Groton,
- Lincoln,
- Littleton,
- Lowell,
- Melrose,
- Pepperell,
- Stoneham,
- Stow,
- Tewksbury,
- Tyngsborough,
- Wakefield,
- Westford, — 19.

No. of towns not heard from, 10.

NANTUCKET COUNTY.

No cases: —
- Nantucket, — 1.

NORFOLK COUNTY.

Cases: —
Bellingham,
Braintree,
Brookline,
Dedham,
Dover,
Foxborough,
Hyde Park,
Medway,
Millis,
Milton,
Needham,
Norfolk,
Quincy,
Sharon,
Walpole,
Wellesley,
Wrentham, — 17.
No cases: —
Medfield,
Randolph, — 2.
No. of towns not heard from, 7.

PLYMOUTH COUNTY.

Cases: —
Brockton,
Hingham,
Rockland,
Whitman, — 4.
No cases: —
Abington,
Hanover,
Hanson,
Kingston,
Pembroke,
Plymouth, — 6.
No. of towns not heard from, 16.

SUFFOLK COUNTY.

Cases: —
Boston, — 1.
No cases: —
Chelsea, — 1.
No returns, 2.

WORCESTER COUNTY.

Cases: —
Fitchburg,
Grafton,
Hopedale,
Leominster,
Milford,
Millbury,
Spencer,
Upton,
Warren,
Westborough,
Worcester, — 11.
No cases: —
Ashburnham,
Barre,
Brookfield,
Clinton,
Douglas,
Gardner,
Hardwick,
Holden,
Hubbardston,
Mendon,
Northborough,
Shrewsbury,
Templeton,
West Boylston.
West Brookfield,
Westminster, — 16.
No. of towns not heard from, 32.

Judging from the preceding tables, Barnstable, Essex and Nantucket counties have been free from sporadic cases even, since no city or town in any one of these counties, from which replies have been received, reports any. It has appeared in every city and town heard from in Bristol and Hampden counties.

The following table gives the date of appearance, so far as received, in each city and town, and also shows whether it was sporadic or epidemic: —

1878.	Wilbraham,	Epidemic.
1879.	Montague,	
1880.	Bellingham, Medway, Millis,	
1881.	Spencer,	Sporadic.
	Blandford, Ludlow, Russell, Swanzey,	Epidemic.
1882.	Hingham, Leominster, Wrentham,	Sporadic.
	Concord, Mansfield,	Epidemic.
1883.	Warren,	Epidemic.
1884.	Attleborough, Holliston, Milford, Watertown,	Epidemic.
1885.	Boston, Fall River, New Bedford, Quincy,	Sporadic.
	Framingham, Hopkinton, Hyde Park, Needham, Sharon, Weston,	Epidemic.
1886.	Brockton, Marlborough, Milton,	Sporadic.
	Ashland, Arlington, Grafton, Natick,	Epidemic.
1887.	Foxborough, Hudson,	Sporadic.
	Cambridge, Hopedale, Millbury, Newton, Sudbury, Waltham, Wellesley, Williamsburg,	Epidemic.
1888.	Maynard, Medford, Westborough, Whitman,	Sporadic.
	Dedham,	Epidemic.
1889.	Belmont, Brookline, Hinsdale, Lexington, Malden, Somerville, Winchester,	Sporadic.

The following towns reported cases, but did not give the year: —

Braintree, Chilmark, Fitchburg, Norfolk, Rockland, Upton, Walpole,	Sporadic.
Dover, Dighton, Monson, Sherborn, Wayland,	Epidemic.

The following tabulation gives the different *counties* in which new territory was invaded each year: —

1878.	Hampden.
1879.	Franklin.
1880.	Norfolk.
1881.	Bristol. Hampden. Worcester.
1882.	Middlesex. Norfolk. Plymouth.
1882.	Worcester.
1883.	Worcester.
1884.	Bristol. Middlesex. Worcester.
1885.	Bristol. Middlesex. Norfolk. Suffolk.

1886.	Middlesex.	1888.	Middlesex.
	Norfolk.		Norfolk.
	Plymouth.		Plymouth.
	Worcester.		Worcester.
1887.	Hampshire.	1889.	Berkshire.
	Middlesex.		Middlesex.
	Norfolk.		Norfolk.
	Worcester.		

Intermittent fever was epidemic in Hampden County at the time when Dr. Adams made his report, so that the first reference to that county in the preceding tabulations is of importance only as indicating the spread of the disease. It was also present in Franklin County, in sporadic cases; but the reference is of value as an indication of new territory invaded, and also as showing one of the towns, Montague, where it became epidemic. In 1880 it passed by Worcester County and made its first appearance in Norfolk, where it seems to have obtained a firm foothold, since from that time until 1889 inclusive it developed in one or more new localities every year save 1881, 1883 and 1884. In 1881 it attacked Bristol County, and invaded new fields in two other years, 1884 and 1885. In the same year, 1881, it attempted to gain entrance into Worcester County, and in every year afterward (except 1885), up to and including 1888, — seven years in all, — it repeated the attempt, but with indifferent success considering the size of the county, for in only five towns has it prevailed as an epidemic. In 1882 it made so successful a raid on Middlesex that this county divides the honors with Norfolk, for in each it invaded new territory in seven different years. In this year, 1882, it also appeared in Plymouth County, but it made no further attempt until 1886 and again in 1888, and it only succeeded in any year in appearing as a sporadic disease. In 1885 the first indigenous cases were observed in Suffolk County. In 1889 it invaded new territory in Berkshire County. It will be noticed that the disease did not follow a regular order of progress from west to east, but occurred irregularly, from Franklin County south-eastward to Norfolk, then southward to Bristol and westward to Worcester, then eastward to Middlesex and rather more southward to Plymouth, and then westward to the Berkshire hills.

A history, more or less in detail, of the appearance and

progress of intermittent fever in the different cities and towns will next be given. The alphabetical order is observed, regardless of either counties or dates, this being, all things considered, the more convenient for reference when looking for the record of any particular locality.

Agawam. — Dr. E. G. Ufford, in 1880, reported that the first cases occurred in 1878, and the number of cases in 1880 as fifty or sixty. Dr. J. W. Hastings reports for this paper that intermittent fever has continued to prevail from its first appearance until the present time. During the first four or five years there were comparatively few cases, but for the next three or four years it prevailed extensively. In the summer and autumn of 1882 he prescribed for one hundred and seventy-seven cases. Since that year there has been a gradual decrease, and in 1889 he reached the minimum number, — forty. As to locality, some of the cases "were near a shallow pond in the western part of the town; others near the Connecticut River, especially in summer, when the nights were foggy; and others near meadows that overflow and then partially dry away. The pond above mentioned is for grist-mill power. Residents near the pond of the Agawam Company have been affected, and there have been cases on high and dry soil away from stagnant and flooded lands."

Amherst. — There were five indigenous cases reported in 1880. Dr. Dwight of North Amherst, and another physician who sent an unsigned report, both state that it has continued to prevail until the present time. One reports "occasionally a case," the other "to some extent." As to season, it has appeared in spring, summer and autumn. The only location mentioned is "on the east side of the Connecticut River, from one to two miles."

Arlington. — The first case appeared about three years ago. It was quite prevalent in 1889. Some of the cases were in the lowest part of the town, and others on high and dry land, one or more cases being on the top of Arlington Heights.

Ashland. — Dr. G. C. Pierce writes that the first case he ever saw there was in the autumn of 1876, tertian type. The patient was a man who had been ditching in a meadow. There were no more cases until the spring of 1886. For that year he gives the number of cases coming under his observation as about ten; for the year 1887, about forty; for 1888, about sixty; and for 1889, about fifteen. Two cases were fatal; one a man of eighty years, and the other a woman of seventy-six, both of whom refused treatment. "It prevailed mostly in the summer season, although cases in winter were sufficiently common." "The majority of cases were in low lands and on the borders of streams. This village is in the fork of two mill streams. The whole village is under the influence of any emanations arising from the reservoirs No. 2 and No. 4 (Boston water supply). We had no malaria here until the construction of those reservoirs was begun. A family of seven, living below Reservoir No. 4, most of the construction of which was done in 1887, had malaria that year and also in 1888. During those years there was a great deal of malaria in the hamlet 'South Ireland' near this same reservoir. There were three cases in 1888, on a hill one hundred and fifty feet high, about one mile west of the village. The decrease in amount of typhoid fever since the appearance of intermittent fever has been very noticeable."

Attleborough. — Reported no cases in 1880. Intermittent fever made its first appearance "about five years ago," according to the replies of four physicians. The period of greatest prevalence was in 1887 and 1888, when there were at least one hundred cases each season. Topographically, Attleborough, and especially North Attleborough and Attleborough Falls, are made up in large part of low, swampy land. Most of the cases were among persons living in these regions or along the banks of Ten Mile River, a small stream which runs through the town. There were quite a number of cases on high and dry land.

Bellingham. — Dr. C. A. Bemis of West Medway writes that intermittent fever has prevailed regularly along Charles

River, during warm weather, for the past eight or ten years. It has been very prevalent near a mill pond in North Bellingham, owned by the Ray Woolen Company. This pond has existed, probably, for fifty years or more. Several years ago, for two consecutive seasons, typhoid fever prevailed extensively in North Bellingham. The cases of intermittent fever have all occurred since the typhoid epidemic.

Belmont. — Dr. R. L. Hodgdon of Arlington reported four cases in Belmont, and Dr. E. H. Stevens of Cambridge writes that "many of the cases seen during the past year have been in Belmont."

Blandford. — Intermittent fever made its appearance in 1881 or 1882. There were a few well marked cases in the north part of the town, in the immediate vicinity of a large reservoir. There were several cases in other parts of the town, where the sanitary surroundings were bad. Dr. W. H. Deane observed cases of typical malaria at an altitude of fifteen hundred feet above the sea.

Boston. — Over thirty physicians report "no cases." Others have observed sporadic cases as follows: —

Dr. Vincent Y. Bowditch writes thus: "Within the last year or two I have come across one or two cases of intermittent fever, which arose apparently in the city; that is, I could not find any history of a previous residence in a malarious region. These cases have arisen among poor people, living in damp, badly ventilated dwellings in the older parts of the city; but the number is so small that I do not think them of consequence, except in supposing that this disease is not common here."

Dr. E. M. Buckingham reports as follows: "I believe that there have been cases of home origin in various parts of the city. I do not know when it began. The last case of which I have personal knowledge occurred in August, 1889."

Dr. Buckingham very kindly furnishes the following notes of cases: —

"April, 1879. Worker in sewer. Doubtful, because he had lived in Brooklyn, N. Y., although he had never had a chill before. Case well marked.

"January, 1882. Visitor of Associated Charities, living at South End. Doubtful, because had one chill in Rome seven years before, which was not treated, and not repeated. Case well marked.

"August, 1885. Two cases, different families, both City Hospital out-patients, both residents of Downer Street, one of them, twelve years old, was born there. Well marked.

"Excluding the first two above, there were three cases certainly of Boston origin, one from Framingham and one from Indian Orchard, all well marked; also a few of doubtful diagnosis. Diagnosis of intermittent made twenty-eight times in five years in out-patients' room of City Hospital. A number of these people were natives of Northern New England and Canada. Some of them certainly brought the disease from elsewhere.

"One of my private cases lived within a few rods of the Roxbury district that was overflowed a few years ago. A new sewer had just been put through the street. Downer street, where two of the cases certainly originated, is on the Brookline line, near the filthy stream that meanders through the new park. The hospital cases seemed to divide into three groups, and miscellaneous; one group being from South Boston, one from the Dover Street and Church Street district, and one in the low ground between the South End and Roxbury. One doubtful case of mine, and a certain one of another physician, occurred about the same time in two nearly adjoining houses backing on an alleyway that was a slough, and has been complained of, independently of these cases, to the local board of health.

"I could hardly have been through the hospital records so soon but for the help of Mr. Dwight and Mr. Fuller, *externes*."

Dr. Elbridge G. Cutler says: "I have only seen two cases in consultation, but they will be reported by others. Have seen two in the hospital, which came from a distance and have disappeared."

Dr. O. W. Doe writes: "I had one case, recurring daily,

in the flooded district at the North End, three years ago. It came on directly after the water had disappeared from the cellar."

Dr. Chas. F. Folsom reports: "In 1886 there were two cases, with all the characteristics of intermittent fever, during the convalescence from typhoid in my wards at the City Hospital; in 1889, two of uncomplicated intermittent fever; the origin of the disease in all cases having been, so far as evidence went, in Boston. One case came from West Dedham Street and one from Northampton Street."

Dr. F. B. Harrington writes: "I have seen four cases in the last year on Charles Street, that I suspected to be of malaria. They were not well-marked cases, but were relieved by quinine. There were daily chills and headache."

Dr. John A. Jeffries says: "The only cases of malaria which have come under my care, and seemed to be native, are two recorded in 'Boston Medical and Surgical Journal,' 1888, p. 423. The first case developed on April 28, 1887; the second one on Sept. 12, 1887. Both cases were in the district bounded by the water, Kneeland, Kingston and Essex Streets."

The foregoing embraces all of the cases of intermittent fever in Boston thus far reported. It seems proper, however, to add the statements of three physicians concerning cases of intermittent neuralgia, intermittent headache, and cases presenting symptoms resembling malaria.

Dr. Francis Minot reports that "it has not prevailed nor does it now prevail in Boston or its vicinity, to my knowledge. I have seen a very few cases in the vicinity which seemed to be genuine intermittents. I have seen many cases of intermittent neuralgia, and a few of intermittent headaches, not clearly neuralgic, but which yielded to quinine, but in most cases not of malarial origin so far as was known. In patients subject to neuralgia the previous existence of *genuine* "malaria" generally imparts a periodic or intermittent character to the neuralgia. A large number of patients believe they have 'malaria' who exhibit no symptoms of that disease."

Under the date of Dec. 18, 1889, Dr. J. B. Ayer, after

giving the history of two cases *developing* in Boston, but *originating* in the Connecticut valley, writes as follows: "During the last summer I saw cases of periodic headache which (in spite of no enlargement of spleen) I fully believe were of malarial type. These cases yielded to large doses of quinine. The most marked case was in a girl three and a quarter years of age, living on West Cedar Street, who had never been far from home. I attended her from June 11 until August 20. I was at a loss as to diagnosis and treatment of the recurrent headaches, and felt that the symptoms pointed to tubercular meningitis; but as patient did not waste away, Dr. C. H. Townsend suggested a possibility of intermittent fever being the diagnosis, and Dr. E. G. Cutler felt that quinine was deserving of trial. Symptoms yielded, patient recovered, and we all feel convinced that this diagnosis was the correct one, although the spleen was not enlarged. I feel convinced (perhaps with insufficient proof) that malarial tendencies are steadily increasing in this neighborhood."

Dr. W. P. Brechin reports a case of a man who had symptoms of malaria after working near the bridge at the lower end of Beacon Street. Dr. Brechin has "observed a few cases in Boston that presented symptoms resembling malaria, but not sufficiently pronounced to make an absolute diagnosis."

Allston District. — Dr. M. L. Brown reports five cases in 1889, all bordering on Charles River.

Brighton District. — Dr. H. E. Marion gives the date of its first appearance as 1887, but has kept no record of cases.

Dorchester District. — In the "Boston Medical and Surgical Journal" for March 3, 1887, Dr. J. S. Greene reported seven cases of intermittent fever near the Neponset River, two of them on the Dorchester side and the others on the Milton side of the river. In April, 1890, Dr. Greene reports four additional cases: "one near south east edge of a swampy track, one at east edge of a piece of woods, one where no predisposing surroundings obtain, and one at east edge of a low, undrained tract."

Braintree. — Under date of June 4, 1889, Dr. T. H. Dearing reported that "we have had three or four cases, in the last four years, of intermittent fever."

Brockton. — Dr. S. J. Gruver gives the date of its first appearance as September, 1886, and saw two cases in 1889. Dr. H. F. Borden has "no date now to go by, but I have three cases in mind, all within about three years." Of these cases, one resided near a swamp, one near springy land which had been upturned to improve drainage, and the other resided on high, springy land, but contracted the fever while at work in what is known as "Vinegar Swamp." Besides these sporadic cases of intermittent fever, Dr. Borden speaks of "many cases of neuralgia of intermittent type, but, in my practice, no decided forms of fever." In answer to the question as to malarial poison being carried up a hillside, Dr. Borden "cannot positively say that it is; but one of my patients lives on high land, and a swamp lies low, in north-east direction from him, and he and his family are subject to neuralgic attacks, at certain times, which partake of a malarial type."

Brookline. — An unsigned circular was received, mailed at "Brookline Station," and therefore is credited to Brookline. Intermittent fever appeared in June, 1889. The reporter has seen four cases, two of them near a stream, and one on low land.

Cambridge. — Dr. J. L. Hildreth writes: "I reported, nearly ten years ago, four cases of the quotidian type of chills and fever, occurring in persons who had never been out of Cambridge. They all occurred on the borders of Fresh Pond, which is the water supply at Cambridge. These four cases were the first indigenous cases, beyond question, that I ever saw." During the year 1889, Dr. Hildreth saw a great many cases of intermittent fever. A large proportion of them were either upon the borders of Fresh Pond, or in that vicinity. They did not seem to be influenced by prevailing winds.

Dr. E. H. Stevens saw his first cases in the summer of 1887. During the year 1889 he treated sixty-two cases, forty-seven of them between September 2 and November 20. More of them were at Parry Brothers' brick yards than in any other one location. Other cases were about Fresh Pond and Alewife Brook. Dr. Stevens writes that the beginning of malaria in Cambridge seemed to be at the time when Fresh Pond became very low, and work was going on to deepen the pond on the east side.

Chicopee. — Three hundred cases were reported in 1880 in Dr. Adams' paper. It still continues to prevail. One physician treated twenty or more cases during the year 1889.

Chilmark. — Dr. W. H. Luce of West Tisbury writes: "In a practice of more than fifty years I have never seen but *one case* that resembled indigenous intermittent fever. A man living in Chilmark who had been at work in a swamp, was seized with paroxysms of ague, of the quotidian type, which lasted a few days only."

Concord. — The first well-defined cases in the practice of Dr. Geo. E. Titcomb were observed in the autumn of 1882. Dr. Titcomb reported at least three cases in 1889. One was a child living near a stream with marshy surroundings; the others were in the village, "which is on the river, and the land not much elevated above water level."

Dr. E. W. Emerson gives the following detailed account of cases coming under his observation: "You asked me to give you in writing what I told you about my first experience of indigenous malaria in Concord. I began practice in this town in 1874, and was in partnership with Dr. Josiah Bartlett, who had then been for nearly half a century a respected and busy practitioner in Concord and adjoining towns. I learned from him that we did not have malaria in our neighborhood, nor did I myself see a case in the eight and a half years in which I was in constant practice in Concord and neighboring towns. In the end of August, 1883, after withdrawal from practice except as a consultant,

I took for a week, I think, my successor Dr. Titcomb's practice, and had a case of marked chills and fever, recurring every other day, and yielding readily to quinine. The sufferer was a young Irish girl who had lived only in Concord after coming to this country. At the same time I had two other cases, less pronounced, but which appeared to me to be simple malaria; one in an Irish girl, serving in the same family with the first, and the other in a lady from Brooklyn who was visiting in Concord, but had never suffered from chills and fever in Brooklyn. That summer our river was especially low, and there had been great drouth; moreover, advantage was taken of this condition of the meadow close by the town to make a house lot there by dumping gravel and ashes, and the surface of the meadow was first taken off and then spread for loam on the new lot. Malaria did not occur in the houses close by, but the servants above mentioned were taken sick in a house cooled in summer by south-west winds blowing over a mile of meadow an edge of which had been thus disturbed. The Brooklyn lady, though living in a house in another part of the town, was close by the Mill Brook, a sluggish tributary to the Concord, and, moreover, constantly called on the people dwelling in the house next to that in which the servants were taken ill. Since that time I have seen no cases of malaria myself, but Dr. Titcomb occasionally has them; and the tenants of the house built, as I have said, on the lot redeemed from the meadows, left it in a few years, because the lady of the house thought she was probably suffering from mild malaria."

DEDHAM. — The disease was first observed in 1888, when it was quite prevalent along the Charles River. It also prevailed in 1889.

DEERFIELD. — No returns have been received for this paper, but a report appears in the State Board of Health report for 1888, in which the statement is made that it was epidemic during the years 1886, 1887 and 1888.

DIGHTON. — No report received by Dr. Adams in 1880, but present report is, "More or less prevalent every year." Prevails at all seasons, but more especially when ground is open.

Dover. — Physicians living in adjoining towns have mentioned "cases in Dover," but have given no details.

Easthampton. — First appeared in 1880, and has continued to prevail ever since, though less in 1889 than in previous years. Dr. F. C. Greene writes: "The most interesting facts known here relative to the matter in question relate to more than five years since, when, after hearing of its approach up through Connecticut, it first attacked a numerous family living near the 'ox-bow,' a stagnant bend or 'old bed' of the Connecticut River, filled with floating logs for a large lumber mill, and containing much of its sawdust. From that family it spread to all the neighborhood, and from that centre through this town and to other towns."

Fall River. — First appearance about 1885. Wholly sporadic, eighty or ninety feet above Taunton River. "A great part of the city is on the slope of a steep, rocky (granite) river bank."

Fitchburg. — Three cases reported. Two of them occurred in March, the other one in the summer. The latter lived near a branch of the Nashua River. The other cases resulted from the use of water from a reservoir connected with the roof of a house. The water was not often used for drinking, but was used for culinary purposes.

Foxborough. — Dr. J. G. S. Hitchcock writes: "It has never *prevailed*, to my knowledge, but a few cases have occurred which seemed to have originated in the town. I have known of no cases within the past year." It made its first appearance in 1887.

Framingham. — Dr. Z. B. Adams wrote a very complete and interesting account of the outbreak of intermittent fever, which was printed in the State Board of Health report for 1885–86. It has continued to prevail up to the present time. During the years 1885 to 1888 inclusive, over one thousand cases were reported by four physicians. It has been

especially prevalent in South Framingham (*vide* physical characteristics in Dr. Adams' paper), along the borders of "Stony Brook" and the Sudbury River (a strip of land a mile in width, extending from Southborough to Wayland), and in the vicinity of the Boston water supply reservoirs. Dr. E. H. Bigelow has observed cases on hills from one hundred and fifty to two hundred feet above tide-water, and one hundred and fifty feet above Sudbury River.

GRAFTON. — First appearance of the disease about three years ago. Dr. W. E. Rice reports twelve cases the first season. Six of these cases were near a meadow which was flowed in winter. To the north-west, whence come the prevailing winds, is a lake which is drawn down, and leaves many acres exposed.

GREENFIELD. — Reported one case to Dr. Adams in 1880. That was the forerunner of an epidemic which has not yet subsided. Dr. A. C. Walker reports over two hundred cases in the last ten or twelve years; last year, 1889, about twenty cases. Most prevalent in river bottoms, near ponds, marshes, and where there has been extensive upturning of soil. Direction of air currents appears to make no difference.

HADLEY — Dr. Franklin Bonney, who reported to Dr. Adams that the number of cases of intermittent fever in 1880 was about one hundred, now writes: "I cannot be very explicit, but probably one-third of the population have had the disease since its first appearance. During the last year there have been but few cases. It has prevailed at all seasons, but mostly in the spring and fall." The Connecticut River skirts the entire western border of the town, a distance of ten miles, with an elbow of five miles, making fifteen miles in all. There are also several mill-ponds, all of long standing, near the residences of some of the people. "There is a popular feeling that the pond at North Hadley had something to do with inducing the disease in that village." Probably no families in town live more than one mile from some one of these bodies of water. The town is

almost wholly level. Since the appearance of the fever, there has been a marked improvement in the sanitary care of home premises, out-buildings, barn-yards, etc.

HINGHAM. — Dr. J. H. Robbins reports eight cases since May 10, 1882, the date of its first appearance. No cases in 1889. One case on the dryest land in town, distant from water or swamps. Others were near swamps, but in no special direction from them. There is a great deal of "meadow, swampy land" in Hingham, but no extensive draining or uncovering of "drowned lands."

HINSDALE — Dr. E. C. Collins writes that he had one case in the spring of 1889. The patient was a man who worked nights in the yard of the Boston and Albany railroad. The yard was near a brook, in a low, marshy locality.

HOLLISTON. — Dr. C. E. Spring gives the date of first appearance as about five or six years ago. Has treated a number of cases each year since; saw fifteen or twenty cases in 1889. People living near a swamp, or in houses with wet cellars, were most frequently affected.

HOLYOKE. — Dr. J. J. O'Connor reported in March, 1881, that there were over five hundred cases in 1880. It has continued to the present time, but to less extent. Cases are seen at all seasons, but more especially in autumn. It has prevailed chiefly in the lower part of the city, near the canals and the Connecticut River; but cases have appeared on high ground and sandy soil. East of the city is a large pond, the water of which is somewhat lowered in summer. North-west is a large swamp, higher than the highest part of the city. Through the city run three canals, which are drawn off every Sunday.

HOPEDALE. — June 1, 1889, Dr. E. C. Atkins of Milford wrote: "In Hopedale malaria has been very common for the past two years." In March, 1890, Dr. F. A. Wilmarth of Milford writes that "intermittent fever" has not prevailed in Hopedale, though he has seen a few well-marked cases;

but the malarial influence, as affecting and complicating diseases, appears to be steadily on the increase. These statements of Drs. Atkins and Wilmarth do not conflict, since one speaks only of "malaria," while the other mentions both "intermittent fever" and "malaria."

HOPKINTON. — Intermittent fever made its appearance "about four years ago." One physician reports "about thirty cases in all," four in the year 1889. During the past three years the streets have been dug up for the purpose of laying water pipes.

HUDSON. — June 3, 1889, Dr. J. L. Harriman wrote: "During the past two years I have had several well-marked cases of intermittent. Have never had any before that *originated* in this vicinity." (No later reports have been received.)

HYDE PARK. — The first cases were seen "about four years ago," since which time there has been a large number. Has prevailed in damp, swampy districts.

LEOMINSTER. — Intermittent fever appeared about 1883 or 1884, and prevailed more then than in later years. No distinct cases in 1889, but rather a "malarial tendency" in some persons.

LEXINGTON. — Dr. Howland Holmes reports three cases in 1889; one in March and two in September. The persons affected lived near meadows; one of the three lived near a brook, also, "whose stream was considerably obstructed." Meadows and brooks were west of the residences of those affected.

LUDLOW. — Intermittent fever appeared about 1881, prevailed for three or four years, and then was succeeded largely by irregular forms of malaria. During 1889 there were only two or three well-marked cases of intermittent. The first cases were near the Chicopee River, which runs through the town; later cases were in more distant locali-

ties. Several cases, but less in proportion and later in appearance, were near the reservoir constructed fifteen or twenty years ago to supply the city of Springfield with water.

Malden. — An unsigned circular contains this statement: "Personally I have not met a case of intermittent fever, but I learn from other doctors that there are a few cases in this city at the present time. There has been considerable upturning of soil, due to laying water pipes."

Mansfield. — First appearance of intermittent fever about 1882; most prevalent in 1887. One physician reports about twenty cases in 1889. Was most prevalent around the reservoir, which was constructed about twelve years ago.

Marlborough. — Dr. E. G. Hoitt, under date of Dec. 19, 1889, writes: "During the past ten years I have treated but four or five cases, and they came from malarial districts. We are soon to put in a system of sewerage, which will necessitate the upturning of drowned lands, with results remaining to be seen." Dr. H. E. Smyth says: "It has prevailed slightly, and does at the present time; but the cases are few and scattered. Most have been in people who have lived in other climates, but have not suffered before living here. I first saw cases about three or four years ago; about five cases the past year."

Maynard. — May 31, 1889, Dr. J. E. Marsh writes: "Had two cases of malarial fever last year, both tertian; one originated here, the other came from Sudbury."

Medford. — Dr. James E. Cleaves writes: "Was told of cases one year ago, but saw none. Have had two marked cases and one mild case, all occurring in September, 1889, near the low, clayey flats about the pits of the Bay State Brick Company. The land is low and wet all about the neighborhood."

MEDWAY. — Intermittent fever appeared about ten years ago, and has prevailed every summer and autumn since, along the banks of the Charles River.

MILFORD — Two dates are given for the appearance of intermittent fever, "about the middle of March, 1884," and "the latter part of the spring of 1888." It has not *prevailed* to any great extent. Many of the cases have been near Cedar Swamp Pond and along the Charles River. (The pond above mentioned is made by a dam across Charles River, for the purpose of furnishing power for a grist and saw mill, and has been in existence many years.) Cases have occurred on hills from three hundred to six hundred and fifty feet high, among people who had not visited the low, swampy localities. Aside from these cases of intermittent fever, the "malarial influence, as affecting and complicating diseases, appears to be steadily on the increase."

MILLBURY. — Over date of Dec. 20, 1889, Dr. Geo. C. Webber reported that "seven or eight years ago" he saw a few well-marked cases. "None of them were very far distant from Blackstone River or tributary streams, which are interrupted by dams at short intervals." Dr. Lincoln writes that he first observed cases in 1887 or 1888; in 1889 he saw five cases. He gives the location as "along the Blackstone River, and also on low lands remote from the river." Dr. Webber states that there are fifteen mill ponds, made by dams in the course of the Blackstone River and its tributaries, within the limits of the town, and all of them are near habitations.

MILTON. — Dr. M. V. Pierce writes: "One case in October, 1886, — quotidian. Man lived on a wharf on the west side of Neponset River, where the flats are uncovered at low tide. No other cases in the neighborhood. Termination favorable."

MONSON. — Intermittent fever made its appearance "more than five years ago" and was at its height about four years ago. So far as observed by Dr. G. E. Fuller, it did not

respect either hill or valley. A few years ago he saw several cases of the tertian type in one family, near the top of Wilbraham Mountain.

MONTAGUE. — Dr. C. C. Messer of Turner's Falls writes that it has prevailed at all times during the past five years, but made its first appearance about ten years ago. Continued to be quite prevalent in 1889. All the cases were near the Connecticut River. A dam was built across the river long before intermittent fever made its appearance. Concerning this dam Dr. E. A. Deane of Montague says: "The Turner's Falls Water Power Company built a dam across the Connecticut River, which flowed an extensive territory of low lands, graded streets, made extensive excavations, filled and drained frog ponds; others have built a village thereon, and *reaped the benefits*."

NATICK. — Dr. George J. Townsend of South Natick observed his first case in that village in September, 1885. Probably other sporadic cases were seen that autumn. In the summer of 1886 it became epidemic in South Natick, along the Charles River, in a region familiarly known as the "West Part," and also in other parts of the town, especially Felchville and a dry, gravelly plateau on the eastern border of Lake Cochituate, with an elevation of twenty to thirty feet above the lake, called "Nebraska Plain." "West Part" is situated west of Lake Cochituate and Lake Cochituate Reservoir, and also west of Natick village. Through it flows Beaver Dam Brook, which drains the Guinea Meadows, a portion of South Framingham in which intermittent fever has been especially prevalent. South and west of that part of Felchville where malaria has been most prevalent is a hollow which receives drainage by gravity. Nebraska Plain is on the opposite side of this hollow. Natick village, where intermittent fever prevailed less than in any of the first-mentioned localities, is situated east of Lake Cochituate and the settling basins on Pegan Brook, built nearly twenty years ago by the Boston Water Board for the purpose of intercepting solid matter of various kinds which found its way into the brook. In the summer of 1888 these dams were taken

away, the solid matter at the bottoms of the basins removed, and the banks were gravelled. At no time, either before the dams were removed or while the work of excavating was going on, was there any outbreak of intermittent fever, either in the immediate vicinity of these basins or in that part of Natick village situated in the course of the prevailing winds from the direction of these basins. The disease prevailed during the warm months of 1886, 1887 and 1888 especially, and in much less degree during 1889. Three hundred cases in all is undoubtedly a low estimate.

NEEDHAM. — Dr. A. D. Kingsbury reports "scattering cases, imported from the banks of the Connecticut River, from 1875 to 1885; since that date many indigenous cases." During 1889 Dr. Kingsbury treated from twenty-five to thirty cases. A majority of the cases were adjacent to water, or low, swampy land; east or north-east, with west or south-westerly, winds.

NEW BEDFORD. — Dr. W. H. Taylor writes that he saw four cases, four years ago, "in localities where zymotic diseases usually prevail, especially where, from peculiar arrangement of strata, a hillside was constantly moist and poorly drained." Dr. Taylor adds the following note: "Physicians of long experience here have assured me that malarial fever was common around the shores of an old mill pond many years ago. The pond has been drained and built over for at least twenty years, and I have no personal knowledge of the correctness of these statements."

NEWTON. — Dr. Henry M. Field writes as follows: "My first clinical experience with it in Newton must have been fully twelve years ago. Investigated very thoroughly, not believing that malarial disease could be *born* in the vicinity of Boston; but established the fact of such origin here beyond question." The disease did not appear in epidemic form until about 1887, although other sporadic cases were seen before that year. Since that date it has prevailed in most, if not all, of the wards of the city, as shown by the following quotations. Dr. Porter of Auburndale reports:

"When first observed, it was among Italian laborers in Weston, at Cambridge Reservoir; soon after at Islington and Riverside, — both skirt the Charles. Later, it appeared in nearly all sections of Auburndale, West Newton and other wards of the city." Dr. W. O Hunt of Newtonville reports: "Many cases near swampy lands; a number where new roads were being constructed." Dr. L. R. Stone of Newton Corner, has heard of cases "near a pond which has a great deal of vegetation along its banks." Dr. F. W. Webber, also of Newton Corner, reports: "Most cases were along the borders of the river, or in the immediate vicinity of some boggy swamp. Possibly south-westerly winds prevail when the disease is at its height." Also Dr. J. F. Frisbie reports: "Near swamp and pond." Dr. J. R. Deane of Newton Highlands reports: "Near upturned soil." Dr. W. H. Hildreth of Newton Upper Falls reports: "Generally near the Charles River." As to the number of cases, Dr. Deane reports about forty for 1889. Dr. Field has "kept no record; can only say, in general terms, that I find indications for more frequent prescribing of quinia than formerly, and in larger doses." Dr. Frisbee: "One case in 1889." Dr. Hildreth: "Not more than six during the past year." Dr. Hunt: "From seventy-three the first year, in lessening number to about twenty-six the past year." Dr. Porter: "A good many; ten or twelve during the past year." Dr. Scales: "About half a dozen; there have been only a few cases in this immediate vicinity." Dr. Stone: "I have not seen it, but have heard of it." Dr. Webber: "It is such an ordinary thing that no note is made of it unless it comes in some specially high or favorable location."

Norfolk. — Under date of June 11, 1889, Dr. J. H. Richardson of Medfield wrote: "I have had four cases, unmistakable, in the town of Norfolk, in persons living close to the banks of the Charles River." No later report has been received.

Northampton. — Intermittent fever made its appearance in 1878 or 1879, and the number of cases in 1880 is given in Dr. Adams' report as one hundred. Under date of

March 27, 1890, Dr. James Dunlap writes that "it was more severe for the first few years, becoming less and less severe in type, till now it has almost ceased." Dr. B. D. Sheedy writes: "Five years ago nearly every other person had it. During the past two years I have not seen nearly so much of it. No record has been kept, but it is estimated that there have been hundreds of cases." The city is situated on low land, and the surrounding territory is very damp. Malaria first appeared on the banks of the Connecticut River, and in the lowest parts of the town; but gradually crept up to higher ground, as Hospital Hill. A case was observed on Mount Tom, one thousand to eleven hundred feet above the river. Dr. Sheedy noticed that every man working in a saw-mill surrounded by water, in which were logs, had the disease, and, as a rule, had it severely; they were compelled to take quinine constantly, or it would return.

Quincy. — Under date of June 4, 1889, Dr. J. H. Gilbert writes: "There have been several sporadic cases of intermittent fever in Quincy within the past four years, although it has not prevailed to any extent." Dr. Gilbert gives the history of one case, a boy aged six and one-half years, which began Jan. 21, 1889, and continued until March 8. Quinine, twelve to fifteen grains daily, had no effect; but the disease finally yielded to Warburg's tincture, one teaspoonful four times a day. "Malaria, not distinctly intermittent fever, has appeared to be an element in the cause of many cases of sickness."

Rockland. — Dr. J. C. Gleason reports that "some years ago there were, I think, two or three indigenous cases near a mill pond which was drawn very low in the summer season."

Russell. — Dr. W. H. Deane of Blandford writes: "I met the most of my malarial cases in the adjoining town of Russell, that portion of it which lay in the valley of the Westfield River. The wave of malaria appeared in this vicinity about eight years ago, *suddenly*, in all places which

were badly situated, as in proximity to swamps, etc. For two or three years it was very prevalent, and then began to slowly subside; and now I never see a case except where the sanitary surroundings are very bad, and then but rarely. The wave *came*, and the wave *went*, in a singular way."

SHARON. — Dr. John Smithwick gives the date of its first appearance as April 5, 1885, and reports seven cases for 1889, all of them either near soil recently upturned, or near "newly cut wood-lots of low level." Five of the cases "had newly turned land at the windward."

SHEFFIELD. — A full account of the outbreak of intermittent fever was given in 1880 by Dr. Adams. The only fact received in answer to present inquiries is that it prevails, "but not to any great extent, with a gradual decline."

SHERBORN. — Dr. A. H. Blanchard writes: "There have been scarcely any cases in my own practice. Cases have occurred in the outskirts of the town (principally in the direction of Ashland and Framingham), which have been treated by other physicians. I have not facts enough to furnish any report."

SOMERVILLE. — Dr. Edward Cowles, medical superintendent of the McLean Insane Asylum, writes that intermittent fever first appeared in the asylum in August, 1889. During August and November there were six cases, all in persons who were inmates of the asylum. There is some marsh land to the east of the asylum buildings, less invaded by salt water than formerly. There has been no disturbance of soil, except the ploughing of two acres of the higher, dry land.

SOUTH HADLEY. — Intermittent fever continued to prevail from 1880 until 1888 or 1889. Impossible to state the number of cases. Two cases proved fatal from congestive chill. One of the first cases of the fever was upon a "high, rocky point of land, about half a mile from where the Connecticut River passes through the Holyoke and Mount Tom divide."

Spencer. — The first authentic case was in 1881, since which time there have been twelve or fifteen sporadic cases, but no epidemic. "About eight years ago, when a long, deep trench was dug for the introduction of water works, there were quite a number of cases of malaria, of the type that is often called 'dumb ague,' along the course of one part of the trench."

Springfield. — Two hundred and fifty cases were reported for 1880 in Dr. Adams' paper. Seven physicians report that intermittent fever still prevails, though it is greatly on the decline. Dr. Daniel E. Keefe observed twenty-nine cases in 1889. It is impossible to make an approximate estimate, even, of the total number of cases for any one year or for all the years, since "druggists treat more cases than doctors," and "people are so accustomed to it that in many cases they do not call a physician." Concerning this point, Dr. Keefe says: "My impression is that the twenty-nine cases mentioned would not convey any correct impression of the prevalence of the disease, and I think that it is a small fraction of the cases treated three years ago. But it has prevailed here so long that the lay people recognize it without calling a physician, and buy quinine pills or some patent medicine. In other cases a successful prescription is passed from one family to a new victim in another, as they do in the West; while others take their quinine in their whiskey, instead of taking it straight." In regard to location, three physicians report that it has been no more prevalent in one part of the city than another. Concerning the topographical surroundings and the various possible causes, the reports agree so closely with those given in Dr. Adams' paper that to quote them would be practically a repetition.

Sudbury. — Dr. Geo. A. Oviatt of South Sudbury gives the date of its first appearance as September, 1887, since which time up to Dec. 19, 1889, he had treated twenty-one cases; twelve of them were in 1889, four of them occurring in November and December. Ten cases were near Sudbury River meadows, which are often flooded.

Swanzey. — The first case was seen in 1881. No estimate of the total number has been obtained; but one physician, Dr. J. L. Wellington, reports ten cases for 1889, some of which were near swamps and streams, others in high and dry localities. The northern part of the town is low, level, and in places swampy; and intermittent fever has been more prevalent there than in other sections of the town.

Taunton. — In Dr. Adams' paper Dr. E. J. Bassett reports three cases in the fall of 1879 and spring of 1880. Dr. J. W. Hayward writes for this report that, so far as he can recollect, the first cases, five or six in number, occurred in September, 1884, at East Taunton, about one-half mile south of a reservoir which was built years before by the Old Colony Iron Company, and drawn off that summer. Sporadic cases have continued to appear, but the disease has never become epidemic. One physician reports ten cases in 1889, a second reports five, and a third reports none.

Upton. — No date is given for its first appearance. Four or five cases in 1889 were not easily accounted for other than as indigenous.

Walpole. — Under date of June 5, 1889, ten cases were reported indirectly by three physicians as having occurred before 1889. No later returns have been obtained.

Waltham. — Dr. Alfred Worcester gives August, 1887, as the date of its first appearance, and estimates the number of cases which he has seen at fifty. Dr. J. W. Willis writes that he has averaged about fifteen cases yearly since it first appeared. During the last few years many new streets have been built and cellars dug. Old streets have been dug up for the purpose of laying water, drain and gas pipes. In the summer of 1886, in the preparation for the construction, on Stony Brook, of the reservoir for Cambridge water works, a mill pond, previously full for many years, was drawn down, the mud from its bottom scraped out, and thousands of loads piled on the land near by. In this immediate vicinity prob-

ably every person, old and young, had intermittent fever. The disease seemed to follow the deep trench in which the water main was carried to Cambridge. It also prevailed in the vicinity of Charles River and the low lands adjoining.

WARREN. — The date of first appearance is given by Dr. J. W. Hastings as 1883, and the first case Dr. Hastings observed was a farmer, who lived on an elevation about twelve hundred feet above sea level. In 1889 Dr. Hastings treated about fifteen cases.

WATERTOWN. — Dr. J. A. Mead gives the date of its first appearance as 1884 and states that there were many cases in 1884, 1885 and 1886. In 1889 he treated only three cases. It prevailed especially in the autumn.

WAYLAND. — Dr. F. W. Jackson of Weston writes that he has observed cases in Wayland in the basin or valley of the Sudbury River, even to its watershed limit.

WELLESLEY. — Intermittent fever appeared in 1887. Dr. E. E. Bancroft observed twelve cases in 1889. Probably as many more were treated by other physicians. Most of Dr. Bancroft's cases were "along the course of a brook and its contiguous low land." Dr. I. H. Hazelton of Wellesley Hills, a village about one mile east of Wellesley village, saw his first indigenous case in September, 1888. During 1889 he treated eleven cases. As regards location, Dr. Hazelton writes that "one family, in which all but the husband, who is away all day, were taken, lived on a piece of land never before cultivated. All of the others had ponds, swamps or brooks to the south-west and west." Dr. F. W. Goss of Roxbury reported one case which came under his care after returning from several weeks' stay in Wellesley.

WESTBOROUGH. — Dr. F. E. Corey reports two cases in the spring of 1888 and one in 1889. The former were *east* of land near the Sudbury River, which, at times, is covered with water; the latter was at the Lyman School, nearly two hundred feet above any stream.

WESTON. — The date of appearance, given by Dr. F. W. Jackson, is August, 1885. During the excavation and construction of the dam for the Cambridge water works, begun in 1885 and finished in 1888, "almost the entire working force was afflicted at different times." Dr. Jackson treated seventeen cases in one day. In 1889 he saw about twelve cases.

WEST SPRINGFIELD. — No direct returns have been received, but Dr. W. W. Gardner of Springfield reports that it is "notoriously prevalent in West Springfield, on the banks of the Connecticut River."

WHITMAN. — Dr. B. F. Hastings reports one case in August, 1888.

WILBRAHAM. — Appeared in North Wilbraham in 1878, and in Wilbraham in 1881. Most of the cases have been near water courses, ponds and swamps; also near the Chicopee River, and the reservoir of the Collins Paper Company, North Wilbraham.

WILLIAMSBURG. — Dr. G. L. Perry, who has been in this town about eighteen months, saw cases soon after beginning practice. In 1889 he treated about twenty-five cases, nearly or quite all of them along the course of Mill River.

WINCHESTER. — Dr. Daniel March, Jr., writes that in the spring of 1889 he "attended a girl, aged twenty, who had a marked cold stage, followed by fever, every other day; and, upon the use of quinine, given on alternate days in anticipation of the chill, all symptoms disappeared." This is the only indigenous case of true intermittent fever which Dr. March has seen in Winchester during his nine years' residence in the town.

WOBURN. — An unsigned circular reports only one indigenous case in eleven years, and that one occurred in September, 1889, near a retaining reservoir of tannery sewerage.

WORCESTER. — Dr. C. H. Davis reports that there is "no intermittent fever at present, but we have had considerable within five years;" estimates the number as "perhaps a dozen, and more than that number of intermittent neuralgia." Dr. Davis also reports two fatal cases of congestive chills. Dr. Oliver H. Everett, under date of Dec. 20, 1889, reports "one case which can be called indigenous. That was a child about ten or eleven years old, who had never been outside of the city. I can not lay my hands on notes of the case, but I remember that it was tertian in type, and recovered quickly. It occurred one year ago last spring." Dr. George E. Francis states that intermittent fever was "slightly prevalent three to five years ago." In 1884 and 1885 he observed three cases. Dr. M. J. Halloran has seen "not more than a dozen cases in five years." Drs. J. M. Barton, Thos. H. Gage, A. C. Getchell, Chas. A. Peabody and E. Warner have no personal knowledge of any indigenous cases.

WRENTHAM. — Dr. Henry S. Kilby of North Attleborough writes: "While I was living in Wrentham, 1878–1884, I saw but three indigenous cases of malaria. They were all in the fall of 1882, in a house on the borders of Mirimichi Pond, South Wrentham. At that time the bottom of the pond was largely exposed, most of the water having been drawn off. The type was tertian, and mild. I have heard of cases at Wrentham Centre since, but have seen none."

In fifteen of the eighty-six cities and towns above reported, intermittent fever had appeared and been recorded in 1880. This leaves seventy-one in which it has appeared since 1880, or, at least, has been recorded for the first time in this paper. Adding these to the forty-seven reported by Dr. Adams, we have (including Deerfield, reported by the State Board in 1888) one hundred and nineteen as the total at the close of 1889.

In comparing the present record with that of 1880, the following interesting facts are noted: In Taunton, Woburn and Worcester, malaria has continued to exist as a sporadic disease only. In Amherst, Deerfield and Greenfield, where

it was sporadic in 1880, it has since been epidemic. In Agawam, Chicopee, Easthampton, Hadley, Holyoke, Northampton, Sheffield, South Hadley, Springfield and West Springfield, it was epidemic in 1880, and continued as such for several years at least, and in some instances was epidemic as late as 1889. Cheshire, Douglas, Hardwick, Huntington, North Adams, Pittsfield and Westminster, which reported cases in 1880, now claim freedom from its presence.

The accompanying maps, by giving what may be called a "bird's-eye view," help to a clearer and more comprehensive understanding of the localities invaded by intermittent fever up to 1880, and its spread since then. Map I. was prepared from data found in Dr. Adams' paper; Map. II. from data furnished for the present report.

The dividing line between sporadic and epidemic must necessarily be an arbitrary one. Ten cases in a town of one thousand inhabitants might be considered by many as sporadic, while one hundred cases in a town with a population of ten thousand would be called an epidemic; and yet the ratio in each instance is the same. It is undoubtedly true that the number of cases observed in every city and town exceeds the number reported, since few physicians have kept accurate records, and many have made no returns.

As regards the prevailing type, thirty-four physicians reported quotidian and forty-five reported tertian; two had observed cases of quartan type, and one a case of double quartan.

Fatal cases, uncomplicated, were reported as follows: by Dr. Pierce of Ashland, two cases that refused treatment; by Dr. Bigelow of Framingham, two cases that refused treatment; by Dr. Hubbard of Holyoke, one case; by Dr. Sheedy of Northampton, one case, — a lady of twenty-eight years, in the second chill; by a physician in South Hadley, two cases from congestive chill; by Dr. Keefe of Springfield, "a few cases of what was diagnosed as congestive malaria or congestive chill;" by Dr. Wellington of Swanzey, one case in 1881; and by Dr. Davis of Worcester, two cases of congestive chills.

Reports as to the season of the year in which it prevailed

indicate greatest prevalence in summer and autumn, with considerable prevalence in spring, and occasional cases in midwinter.

In reply to the question as to the subsidence, in any degree, of typhoid fever since the appearance of intermittent fever, forty-three physicians give affirmative answers, and twenty-eight give negative answers. Four or five physicians report entire disappearance of typhoid fever during the prevalence of intermittent fever, but say that, since the subsidence of the latter, typhoid fever has returned. As to any modification in type, duration or diarrhœal tendency, so few answers have been received that no conclusions can be drawn.

Concerning malaria, as either complicating or modifying other diseases, most of the answers relate to professional experiences either in the army or in other States; and so, while of interest, have no direct relation to the present investigation.

Only a few answers have been received to the following question: "If malaria has not prevailed in your vicinity, please state whether any of the conditions specified in question No. 2 (f) exist in your town." (The conditions specified are "ponds, swamps, streams or reservoirs," or "any extensive upturning of soil or any draining or uncovering of so-called 'drowned lands.'") The replies received are as follows: —

Dr. Geo. R. Fessenden of Ashfield writes: "We have a reservoir which is usually drained off in summer, and smells badly, as it is muddy. It is just at upper edge of village; prevailing wind blows from it through the village. Also a large wet meadow in another part of the town, where it is always foggy at night, and very damp."

Dr. W. N. Cowles of Ayer writes: "This village has, on two-thirds of its circumference, a chain of shallow ponds and marshy lands."

Dr. L. T. Newhall of Brookfield writes: "Although on a hill, the town is practically surrounded on three sides with swampy meadows, — on north, west, and south sides. Prevailing winds inclined to be from the south and west."

Dr. D. E. Thayer of Cheshire says: "The Adams and

Cheshire Reservoir is one-half mile south of Cheshire, and stretches four miles, or nearly to Berkshire. In the dry months there is a large surface from very low water exposed to the sun, and a vast amount of vegetable decomposition about the edge of it."

Dr. C. L. French of Clinton writes: "We have in the centre of the town of Clinton a pond or reservoir owned by the Bigelow Company, which has been drawn off, and a channel dug through it for building a sewer. There have been several cases of typhoid fever on the banks of this pond." Another physician states that this pond receives more or less sewage, and is offensive to sight and smell.

Dr. W. W. Schofield of Dalton says: "We have a number of ponds and two reservoirs, with people living about them; but none of the inhabitants have malaria."

Dr. G. B. Underwood of West Gardner answers: "There are a few swampy lands in town; there is quite an extensive swampy district in the south-eastern part of the town, and extending into Westminster and Hubbardston. I have thought malaria would be quite likely to develop in this district some day."

Dr. Thomas Conant of Gloucester states that "swampy land occurs near centre of town, surrounded by dwellings."

Dr. W. B. Warren of Groton writes: "We have quite a strip of improperly drained land, not more than one-sixteenth of a mile from centre of town."

Dr. Geo. N. Munsell of Harwich writes: "Several years ago, when marshes and swamps were being converted into cranberry culture, we had typhoid fever prevailing, of a malarial type, with remittent form, very severe, and largely fatal; but of late years we note the absence both of 'cause and effect.'"

Dr. I. F. Galloupe of Lynn states that "all of the conditions referred to exist in abundance."

An unsigned circular from Orange contains the following: "There is a pond on Miller's River, east of the centre of the village. There is swampy land east of the village, and a 'pond hole,' so called, west of village, the latter being in course of filling. So far as I am aware of the facts, there are very few cases, and perhaps not any, developed here;

but, if a person has had intermittent fever before coming here, he is liable to a return of his trouble."

Dr. F. K. Paddock of Pittsfield writes: "When the epidemic occurred in 1878, the cases were nearly all about an artificial pond of over twenty years' formation. The pond remains unchanged, and there have been no cases since 1883."

Dr. F. W. Brigham of Shrewsbury says: "A number of families live very near — I might almost say in — 'ponds, swamps and streams,' and these families have had no unusual sickness."

Dr. E. P. Colby of Wakefield gives this answer: "Two lakes, the larger of which from October to May overflows a large surface of swamp land from a dam about half a mile below the outlet. In early summer the marsh odor is quite perceptible."

Dr. John Yale of Ware writes: "A two-hundred-acre pond was drawn down to fifty acres two summers, about 1868 and 1869. Before the pond was made, in 1861, cases of typhoid fever were severe in the vicinity of the marsh, which was afterward covered by the pond; and, though the inhabitants — fifty living within one-fourth mile of pond — were afraid, they suffered no fever or malaria of any kind, and never were more healthy."

Dr. Forbes of Brookfield says: "We have a pond drained by a manufacturing company of Warren, and part of the year (in summer) there are exposed several hundred acres of so-called drowned lands; but, contrary to expectation, there have resulted no cases of intermittent or other fevers traceable to above causes."

Dr. Mossman of Westminster gives the following reply: "We have a meadow covering about fifty acres, which has been covered with water continuously for several years, and is surrounded by several dwellings. This body of water was drawn off entirely for some weeks this fall, beginning in latter part of August or first of September, and emitted a terrific odor of decayed vegetable matter. No trouble has followed; the ground is now covered with water. We have a large tract of land from two to three miles in extent, and perhaps from one to two hundred feet wide, much more in

places, which has always been covered for manufacturing interests. This past summer that has been drawn low, and continues so now. There are many dwellings along the immediate vicinity of this region, but there have been no diseases that I could attribute to the decayed vegetable matter."

Dr. B. T. Church of Winchester writes: "Intermittent fever is unknown here, and yet we are upon the borders of 'Mystic' and Wedge ponds, with a large pond (unnamed) nearly in our centre, and a filthy stream called the 'Abbajona River' running through our centre."

Dr. Holmes, in his essay, named fourteen cities and towns in which there had been indigenous cases of intermittent fever at some date more or less remote. These localities were Adams, Boston, Deerfield, Great Barrington, Greenfield, Groton, Hatfield, Hopkinton, Northampton, Pittsfield, Plymouth, Sheffield, Stockbridge and West Stockbridge. In 1880, when Dr. Adams made his report, it had reappeared in ten out of thirteen of the above-named places from which he received returns. Since then it has reappeared in two more, leaving only Adams and Groton free, so far as known; and of these last two, Groton alone gives answer, Adams having made no returns to the writer.

Dr. A. Hosmer of Watertown, when writing to Dr. Adams in 1880, mentioned an indigenous case which occurred twenty-five years before in the practice of his uncle, the late Dr. Hiram Hosmer. The case is of especial interest now, because the patient lived on the shore of Fresh Pond, where so many cases have occurred during the recent outbreak in Cambridge and its vicinity.

In studying the local conditions in the eighty-six cities and towns which have reported cases of intermittent fever, the facts are found to be the same as in former epidemics; viz., that by far the greater number of cases occurred near ponds, lakes, reservoirs, streams, marshes, "drowned lands," upturned soil, and localities more or less infiltrated with sewage. Sixty-four of the cities and towns make replies in harmony with the above; the other twenty-two do not state the local conditions.

The above conditions are *factors*, only, in the outbreak of

this disease in these regions where it is not endemic; they alone are not a sufficient cause else, logically, it would have appeared in many places which it has passed by. Why has it so generally skipped the towns in Worcester County, not even appearing in towns along the Nashua River, as Clinton, which has in its midst conditions such as are described by Dr. French and another physician? Why has the valley of the Merrimac River been so far exempt? Why, especially, has the valley of the Concord River escaped its visitations, since it has invaded every town on the Sudbury River, from its rise in Hopkinton to its junction with the Assabet River in the town of Concord (these two rivers uniting to form the Concord River)? Why has it appeared in nearly all of the cities and towns along the Charles River, and omitted those bordering on the rivers above named?*

To ascribe an outbreak of intermittent fever to an abrupt and marked change in temperature, is not a sufficient answer; for the valleys of the Concord, the Nashua and the Merrimac are subject to the same general variations as those of the Charles and the Sudbury; and the same is true, if the theory be advanced that malarial fevers are due "not to marsh poison, but to the debilitating influence of long-continued heat." Grant that it is a truth, "generally accepted, that malaria, like other infectious diseases, never arises spontaneously, but that the introduction of a germ is necessary," and no progress has been made in answering these questions. Grant, also, that "water is almost certain to prove to be its (the germ's) habitat, and the vehicle by which this microbe enters the human organization," and we have not explained why and how it omits certain localities and appears in others. This much, however, is true; viz., that the appearance and spread of intermittent fever in Massachusetts afford an opportunity for an investigation which, so far as known to the writer, has never been systematically undertaken. Were careful examination made of the waters in the marshes, swamps, stagnant pools, streams and ponds

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* This last question suggests the following interesting fact; viz., that the Charles and the Sudbury rivers both have their origin in Hopkinton, a town where, years ago, "before the swamps were cleared and drained, the inhabitants used to be subject to the *fever and ague*." (Stimson's Historical Collections, 1st Series, iv. 15.)

of regions as yet free from this disease, and a second examination made of the waters in any of these localities in which it afterwards appeared, the facts as to the conditions of the waters *before* and *after* its appearance would be determined, and possibly new light be thrown on the germ theory.

This paper is not even a clinical history of intermittent fever in this State, but rather a report of progress. The time has not arrived for its history to be written. The end is not yet. There is little doubt that the germ, or whatever be the active cause, will appear in "fresh woods and pastures new."

PHYSIQUE OF WOMEN IN MASSACHUSETTS.

THE PHYSIQUE OF WOMEN IN MASSACHUSETTS.

By Prof. H. P. Bowditch, M.D.

In the eighth annual report of the State Board of Health of Massachusetts was printed an article entitled, "The Growth of Children." In this paper were embodied the results of a study of the height and weight of school children of Boston and vicinity, about 24,500 measurements having been made, chiefly upon pupils of the public schools of the city. Tables and curves were given, showing the average heights and weights of school children from five to eighteen years of age, of both sexes, and of parentage of various nationalities. In a subsequent article, two years later, the same data were further discussed, with a view to ascertaining the relative importance of race and environment in determining the rate of growth.

In order to enlarge the body of statistics from which conclusions could be drawn, the State Board of Health, Lunacy and Charity, in 1880, issued the following circular: —

Commonwealth of Massachusetts.

State Board of Health, Lunacy and Charity,
Department of Health, State House,
Boston, Jan. 1, 1880.

Dear Sir: — As a contribution to the vital statistics of Massachusetts, the State Board of Health, Lunacy and Charity desires to suggest the importance of collecting observations upon the physique of the inhabitants of the State. The usefulness of such an investigation will be evident from a consideration of some of the problems upon which it will throw light. These may be briefly enumerated as follows: —

1. The influence of geographical and climatic conditions on the growth of children and on the physique of adults.

2. The number of generations necessary for the complete development of the influence of changed climatic conditions on the physique of a given race.

3. The comparative effect of city and country life on the growth and development of the human race.

4. The relation between diseases and the rate of growth.

5. The effect of local hygienic conditions on the physique of children and adults.

That the results of the inquiry may have the greatest possible value, it is desirable that measurements should be made upon individuals of all ages and of both sexes. In pursuance of this object, the Board will be glad to co-operate with superintendents of public institutions, both charitable and penal, with persons having facilities for making observations in factories and mills, with school committees, with principals of academies and colleges, with fathers of families, and with all who are interested in this branch of scientific investigation.

To secure uniformity of method, the Board will distribute gratuitously, to all who desire to assist in this research, blank cards, on each of which are to be recorded the statistical data relating to a single individual.

If you desire to aid in this investigation, you are requested to state the number and sex of the persons in regard to whom you will be able to collect any or all of the above-mentioned statistical data. The Board will then gladly supply you with the necessary number of blank cards, and furnish you with full instructions as to the best method of taking and recording the measurements. The use of the metric system for this purpose is attended by so many and such decided advantages, that the Board is willing, if desired, to furnish certain simple forms of apparatus to facilitate the work. If, however, it is for any reason impossible to employ the metric system, measurements recorded in inches and pounds will be gladly received, and the conversion afterwards made at this office.

The statistics collected in this way will be placed in the hands of Prof. H. P. Bowditch, to whose articles on the growth of children in the eighth and tenth reports of the State Board of Health, investigators in this field of research are referred.

In behalf of the State Board of Health, Lunacy and Charity,

Very respectfully yours,

CHARLES F. FOLSOM, M.D.,

Secretary.

To those who expressed a willingness to aid in this investigation blank cards were forwarded, printed on both sides, as follows: —

FEMALES.] FOR A SINGLE SET OF OBSERVATIONS. [SEE THE OTHER SIDE.

Record all linear measurements at nearest centimeter; all weights at nearest kilogram.

Name (or initials), ______________________ *Age,* ______ *yrs.* ______ *mos.*

Height, without shoes, ________. *Sitting height,* ________. *Finger reach,* ______.

Chest girth, inspire, ______; *expire,* ________. *Weight,* (in ordinary in-door clothes,) ______.

Nationality of
- *Father,* ____________. *Color of Eyes,* ________ *Color of Hair,* ________.
- *Mother,* ____________. *Birthplace,* ______________________.
- *Paternal Grandfather,* ________. *Occupation (of husband if a married woman), (of parents if a minor).*
- *Paternal Grandmother,* ________.
- *Maternal Grandfather,* ________. ______________________.
- *Maternal Grandmother,* ________. *Name (or initials) of observer.*

(This card when filled is to be returned to Sec. of State Board of Health, Lunacy and Charity, State House, Boston, Mass.) ______________________

The Height is to be taken in an upright position, without shoes, the feet being close to the measuring rod. If, in the case of infants, it is necessary to measure in a recumbent position, the fact should be stated.

The Sitting Height is the vertical distance between the top of the head and the surface upon which the individual is seated.

The Finger Reach is the distance between the tips of the middle fingers when the arms are extended horizontally, the breast and arms being in contact with a wall.

The Chest Girth should be taken after a forcible inspiration and also after a forcible expiration, the measuring tape being passed horizontally round the chest on a level with the nipples, over only a single garment. This measurement is to be taken only on men and children.

The Weight is to be taken in ordinary in-door costume. In the case of children less than ten years of age, it is to be recorded at the nearest tenth of a kilogram.

The Color of the Eyes is to be recorded as blue, gray, brown or black.

The Color of the Hair is to be recorded as fair, golden, red, brown, black or gray. If gray, record also, if possible, the original color.

The Nationality is determined by the place of birth.

The Occupation should be given so as to indicate as far as possible the degree of comfort in which the individual lives.

See also article on "Anthropometrical Methods," tenth annual report Massachusetts State Board of Health, 1879, p. 55.

The advantages of this card method of collecting statistics are fully set forth in an appendix to the second of the above-mentioned articles.* To the explanations there given it need only be added that the short vertical lines, one centimeter apart, printed at the

* See tenth annual report of the Massachusetts State Board of Health, 1879, page 55.

top of the card, are intended to aid in marking the cards coming from any one institution or locality, so that they may be distinguished, when mixed with others, in sorting them with reference to any particular statistical inquiry. The marking was effected by screwing all the cards belonging to any one institution into a vise, and scoring the tops of them with a hand-saw at one or more of the vertical lines. A record being kept of the scored lines corresponding to each institution, it was always easy to identify the cards belonging to it.

The Board also authorized the construction of several sets of weighing and measuring apparatus which were sent to the different institutions in turn, in order to secure uniformity in the method of making the observations. By these means measurements were obtained in the following institutions, public and private, during the years 1881–85 :—

Name of Institution.	Number of Observations.		Name of Observer.
	Male.	Female.	
Wellesley College, . . .	–	302	Miss E. A. Nunn.
Mt. Holyoke Seminary, . .	–	203	A. A. Richardson, M.D.
Smith College, Northampton,	–	92	Lucy B. Hunt.
Normal School, Westfield, .	11	106	J. G. Scott.
Normal School, Bridgewater,	39	129	A. C. Boyden.
Normal School, Worcester, .	–	38	E. H. Russell.
Normal School, Framingham,	–	65	Miss E. Hyde.
Practice School, Framingham,	21	41	Miss E. Hyde.
Private School, Boston, . .	–	40	Miss Selma Wesselhoeft.
Private School, Boston, . .	–	35	Miss Ireland.
Private School, Boston, . .	–	25	Miss Gibbens.
Reform School, Westborough,	119	–	C. A. Robbins.
Reform School, Lancaster, .	–	70	N. Parker Brown.
Reform School, Lancaster, .	–	73	Miss Putnam.
Farm School, Boston, . .	97	–	F. M. Barrett.
Conservatory of Music, Boston,	–	127	S. L. Tourjée.
Almshouse, Tewksbury, .	37	200	Dr. Lathrop.
	324	1,546	

To the intelligent co-operation of the above observers the success which has attended the investigation is chiefly due.

The publication of the results of this research has been delayed in the hope that they might be embodied in a comprehensive treatise on anthropometry in Massachusetts ; but

the pressure of other duties has thus far prevented the preparation of such a work, and there seems to be no probability that in the immediate future such a task can be undertaken. Moreover, anthropometrical investigations have, in recent years, been carried on under the auspices of Harvard College, on a larger scale and in a much more thorough manner than was contemplated when these data were collected. The development of the human physique in Massachusetts is, therefore, a subject the discussion of which may properly be postponed till the data constantly accumulating in the hands of the Director of the Hemenway Gymnasium shall be numerous enough to enable him to draw positive conclusions upon the numerous questions to which his investition is directed. It has, therefore, been decided to present a few of the most obvious results derived from the study of the data thus far collected, and to point out some of the questions to the solution of which they may contribute in the hands of future investigators.

It will be observed that, in the above list, the observations on females are much more numerous than those on males. This was due to a special effort to obtain statistics relating to the female sex, which, in most anthropometrical researches, has been strangely neglected, though in all questions relating to the growth and development of the race its importance is at least equal to that of the male sex.

With the exception of the observations made at the Tewksbury Almshouse, which were set aside for special study, and have not been incorporated in any of the following tables, the great bulk of all the data were collected from individuals between the ages of seventeen and twenty-four years. Now, at the age of seventeen years, most girls have nearly completed their growth, as will be seen by a reference to the curves on Plate I in the above-mentioned article on the growth of children, in the eighth annual report of the State Board of Health. It therefore seemed possible, by means of the data at our disposal, to obtain a fairly correct idea of the physical type of the adult young woman of this community. One thousand one hundred and seven cards were found to contain data suitable for this determination, and attention was at first directed only to the record of the

height, weight, sitting height and finger reach, or stretch of arms, as it may more properly be called. As these last two measurements are interesting chiefly for the light they throw on the proportionate development of different parts of the body, their absolute values are less important than their relation to the total height of the individual. As a preliminary to tabulation, therefore, the absolute values of the sitting height and stretch of arms on each card were converted into percentage values of the total height. The cards were then treated by the method described in the appendix to the above-mentioned supplementary article on the growth of children, published in the tenth annual report of the State Board of Health.

Although, for the determination of the physical type of the adult young woman, the observations were to be used without regard to the age or the institution to which the individual belonged, yet, with a view to some future possible utilization of the statistics, the cards were at first sorted with reference to both these points. Thus the first tabulation showed, for each age and for each institution, the number of individuals observed, at each centimeter of height, each kilogram of weight and each half per cent. of sitting height and stretch of arms. Tables 1 to 4 give the result of this first tabulation after the observations had been added together, without regard to age or the institution in which the observations were made. Thus Table 1 shows that, out of 1,107 women of seventeen years of age and upwards whose height was measured, one was 139, one 141, four 143 centimeters high, and so on. From a table of this sort the average height is easily calculated, by multiplying each height in centimeters by the number of observations recorded at that height, adding the products together, and dividing the sum by the total number of observations. Average values for the dimensions recorded in the other tables are obtained in a similar manner.

TABLE 1.

Showing Distribution of Observations on Height of Women in Massachusetts (Seventeen Years Old and upward).

Height in Centimeters.	No. of Observations.	Height in Centimeters.	No. of Observations.	Height in Centimeters.	No. of Observations.	Height in Centimeters.	No. of Observations.
139	1	149	15	159	75	169	12
140	–	150	28	160	64	170	13
141	1	151	29	161	81	171	3
142	–	152	36	162	68	172	4
143	4	153	45	163	56	173	–
144	4	154	59	164	49	124	5
145	2	155	65	165	56	175	–
146	6	156	59	166	44	176	1
147	8	157	73	167	21	177	1
148	12	158	86	168	21		

Total number of observations, 1,107. Average height (without shoes) = 158.76 centimeters.

TABLE 2.

Showing Distribution of Observations on Weight of Women in Massachusetts (Seventeen Years Old and upward).

Weight in Kilograms.	No. of Observations.	Weight in Kilograms.	No. of Observations.	Weight in Kilograms.	No. of Observations.	Weight in Kilograms.	No. of Observations.
32	1	46	19	60	60	74	3
33	–	47	32	61	52	75	8
34	–	48	30	62	39	76	1
35	1	49	43	63	29	77	5
36	–	50	61	64	28	78	1
37	2	51	51	65	22	79	3
38	1	52	56	66	20	80	3
39	1	53	68	67	17	81	2
40	5	54	70	68	16	32	1
41	1	55	37	69	4	83	–
42	9	56	64	70	11	84	–
43	4	57	62	71	9	85	–
44	12	58	42	72	2	86	3
45	12	59	74	73	8		

Total number of observations, 1,105. Average weight (in ordinary in-door costume) = 56.51 kilograms.

TABLE 3.

Showing Distribution of Observations on Sitting Height as Percentage of Total Height of Women in Massachusetts Seventeen Years Old and upward.

Per cent. of Height.	No. of Observations.	Per cent. of Height.	No. of Observations.	Per cent. of Height.	No. of Observations.	Per cent. of Height.	No. of Observations.
37.5	1	42.5	–	49.5	2	55.5	49
38.	–	44.	–	50.	6	56.	28
38.5	1	44.5	–	50.5	23	56.5	10
39.	1	45.	–	51.	44	57.	8
39.5	–	45.5	–	51.5	60	57.5	1
40.	1	46.	1	52.	119	58.	1
40.5	1	46.5	–	52.5	111	58 5	2
41.	–	47.	2	53.	156	59.	–
41.5	–	47.5	1	53.5	177	59.5	–
42.	–	48.	–	54.	121	60.	–
42.5	–	48 5	–	54.5	101	60.5	1
43.	–	49.	4	55.	73		

Total number of observations, 1,106. Average sitting height = 53.24 per cent. of total height.

TABLE 4.

Showing Distribution of Observations on Stretch of Arms as Percentage of Total Height of Women in Massachusetts Seventeen Years Old and upward.

Per cent. of Height.	No. of Observations.	Per cent. of Height.	No. of Observations.	Per cent. of Height.	No. of Observations.
93.	3	98.5	34	104.	24
93.5	5	99.	30	104.5	22
94.	2	99.5	81	105.	15
94.5	3	100.	182	105.5	13
95.	8	100.5	118	106.	7
95.5	9	101.	56	106.5	3
96.	14	101.5	56	107.	5
96.5	10	102.	91	107.5	3
97.	26	102.5	88	108.	–
97.5	47	103.	46	108.5	1
98.	71	103.5	31		

Total number of observations, 1,104. Average stretch of arms = 100.54 per cent. of total height.

It will be observed that in Table 3 five of the observations are widely separated from all the rest, showing that five of the women who were measured had a sitting height from 37.5 to 40.5 per cent of their total height; while, with the exception of these five cases, the smallest percentage sitting height recorded was 46. This wide separation of a group of cases from the great mass of the observations suggests the influence of some abnormal cause of variation. It seems not improbable that in these cases some deformity (*e. g.*, spinal curvature) may have produced a great diminution in the sitting height; but, in the absence of any precise information on the subject, it has been thought best to include them in the table. Their effect upon the average percentage sitting height is inconsiderable. By rejecting them, this value is raised to 53.3 per cent., and thus becomes identical with the "median value," as will be shown below in Table 5.

It is evident that the arithmetical average represents but very imperfectly the series of observations from which it is calculated, since the same average value may be obtained from sets of observations differing very widely in their distribution. For instance, the two series of numbers 24, 25, 26, and 5, 25, 45, both give the average value 25. It is also evident that tables of distribution such as those above given are inconvenient, on account of their not being readily comparable with similar tables in which the total number of observations is different.

Various devices for overcoming these difficulties have been suggested by statisticians; but the scheme of "percentile grades" as proposed by Francis Galton, F.R.S., in 1885, and fully elaborated by him in his recent work on "Natural Inheritance,"* is perhaps better adapted than any other to display the results of a statistical inquiry, and to facilitate a comparison between various sets of observations. In this scheme are given values which are surpassed or unreached by various percentages of the total number of observations. In Table 1, for instance, five per cent. of the total number of observations (*i. e.*, 1,107) is 55.35. Now, in this table, since the heights are recorded at the *nearest* centi-

* Macmillan & Company, London & New York, 1889.

meter, it is evident that each successive group includes the observations between the half centimeter below and the half centimeter above the height recorded in the table. By adding together the numbers in the successive groups, we find that the sum of all the observations, at heights up to 149.5 centimeters inclusive, is 53; and, by adding the next group of 28 observations, the sum 81 is reached. Now, since 55.35 is between 53 and 81, it is evident that the height below which five per cent. of the observations fall is between 149.5 and 150.5 centimeters. The exact height can readily be calculated by interpolation. Thus the fraction of a centimeter which is to be added to 149.5 to give the required height, is obtained by dividing 2.35 (*i. e.*, 55.35 — 53) by 28 (*i. e.*, the number of observations at 150 centimeters). This fraction is 0.08; and therefore 149.58 centimeters is the height below which five per cent. and above which ninety-five per cent. of the observations fall. In a similar way, the heights corresponding to other percentages can be obtained, and a table constructed which presents in a very compact form the result of a large series of observations.*

Thus, in the first, fourth, seventh and tenth lines of Table 5 will be found the percentile distribution of the observations contained in tables 1, 2, 3 and 4 respectively; while in the second, fifth, eighth, ninth, eleventh and twelfth lines are introduced, for purposes of comparison, the results of similar observations made by Dr. D. A. Sargent,† director of the Hemenway Gymnasium, upon individuals of both sexes, in this community; and in the third and sixth lines are given the figures obtained by Galton‡ in his measurements of English women at the anthropometric laboratory in the international exhibition of 1884. In the lines numbered 1*a* to 6*a* the values given in the first six lines in centimeters and kilograms are reproduced in inches and pounds, to facilitate comparison with tables in which the English weights and measures are used.

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* A geometrical method of determining the values corresponding to the various percentile grades is given by Francis Galton in an article on "Anthropometric Percentiles," Nature, Vol. 31, page 223.

* Scribner's Magazine, Vol. 172.

† Natural Inheritance, London, 1889, page 200.

Table 5.

	Subject of Measurement.	Name of Observer.	Age.	Sex.	No. of Observations.	Unit of Measurement.	Values at the Under-mentioned Percentile Grades. 5 Per Cent.	10 Per Cent.	20 Per Cent.	30 Per Cent.	40 Per Cent.	50 Per Cent.	60 Per Cent.	70 Per Cent.	80 Per Cent.	90 Per Cent.	95 Per Cent.
1	Height (without shoes), ...	Bowditch, .	17 years and upward,	F.	1,107	Centimeters, .	149.58	151.52	154.01	155.78	157.44	158.77	160.37	161.82	163.67	165.82	167.72
2	Height (without shoes), ...	Sargent, .	16–26 years, . .	F.	1,835	Centimeters, .	150.1	151.9	153.9	155.9	157.5	159.1	160.5	162.0	164.1	166.6	168.4
3	Height (without shoes), ...	Galton, .	23–51 years, . .	F.	770	Centimeters, .	149.5	152.2	155.7	157.7	159.2	160 7	162.2	164.0	165.7	168.7	171.0
4	Weight (in ordinary in-door clothes), .	Bowditch, .	17 years and upward,	F.	1,105	Kilograms, . .	45.82	47.85	50.28	52.33	53.97	56.07	58.00	59.75	61.85	65.82	69.93
5	Weight (without clothes), ...	Sargent, .	16–26 years, . .	F.	1,901	Kilograms, . .	42.0	44.0	46.3	49.0	50.4	52.0	54.0	55.4	58.6	62.2	65.8
6	Weight (in ordinary in-door clothes), .	Galton, .	23–26 years, . .	F.	276	Kilograms, . .	46.3	47.7	49.9	51.7	53.6	55.4	58.6	59.9	61.7	64.5	67.6
7	Sitting height, ...	Bowditch, .	17 years and upward,	F.	1,106	Per cent of height,	50.87	51.43	52.05	52.54	52.95	53.30	53.61	54.01	54.51	55.17	55.70
8	Sitting height, ...	Sargent, .	16–26 years, . .	F.	about 2,000	Per cent. of height,	50.6	51.1	51.6	52.1	52.4	52.7	53.1	53.4	53.9	54.4	54.9
9	Sitting height, ...	Sargent, .	16–26 years, . .	M.	about 2,000	Per cent of height,	50.2	50.5	51.1	51.6	52.0	52.2	52.6	52.9	53.3	53.8	54.3
10	Stretch of arms, ...	Bowditch, .	17 years and upward,	F.	1,104	Per cent. of height,	96.77	97.57	98.58	99.68	100.02	100.36	100.92	101.83	102.46	103.47	104.79
11	Stretch of arms, ...	Sargent, .	16–26 years, . .	F.	about 2,000	Per cent. of height,	97.0	97.9	98.8	99.7	100.3	100.8	101.3	101.9	102.9	103.8	104.5
12	Stretch of arms, ...	Sargent, .	16–26 years, . .	M.	about 2,000	Per cent. of height,	99.1	100.0	100.9	101.7	102.2	102.8	103.4	104.0	104.8	106.0	106.8
1 *a*	Values of line 1 converted into, ...					Inches, . . .	58.9	59.7	60.6	61.3	62.0	62.5	63.2	63.7	64.5	65.3	66.0
2 *a*	Values of line 2 converted into, ...					Inches, . . .	59.1	59.8	60.6	61.4	62.0	62.6	63.2	63.8	64.6	65.6	66.3
3 *a*	Values of line 3 converted into, ...					Inches, . . .	58.9	59.9	61.3	62.1	62.7	63.3	63.9	64.6	65.3	66.4	67.3
4 *a*	Values of line 4 converted into, ...					Pounds, . .	100.9	105.0	110.8	115.3	119.0	123.7	127.9	131.7	136.2	145.0	154.1
5 *a*	Values of line 5 converted into, ...					Pounds, . .	92.6	97.0	102.0	108.0	111.0	114.6	119.0	122.0	129.0	137.0	145.0
6 *a*	Values of line 6 converted into, ...					Pounds, . .	102.0	105.0	110.0	114.0	118.0	122.0	129.0	132.0	136.0	142.0	149.0

meter, it is evident that each successive group includes the observations between the half centimeter below and the half

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* Scribner's Magazine, Vol. 172.

† Natural Inheritance, London, 1889, page 200.

The figures in the column headed 50 per cent. give the measurements which are exceeded by one half and not reached by the other half of the individuals measured. These values are termed by Galton "median values" (or M) and are considered by him (at least in the observations which he discusses) as practically the same as the arithmetical means or averages.* It will be observed that in Table 5 the median values do not differ materially from the average values given in tables 1, 2, 3 and 4. The median and the average values of the height and sitting height are almost identical; while in the case of weight and stretch of arms, the median values fall somewhat short of the averages.

It is evident that, when the values at the lower percentile grades fall short of the median value by *the same amount*, the values at the higher percentile grades exceed it (or, in Galton's words, when "the curve of the scheme is symmetrically disposed on either side of M"), the median and average values will be identical. When, however, the *lower* percentile values fall short of the median value *more* than the higher percentile values exceed it, the average will be less than the median value; while a difference in the opposite direction will cause the average to exceed the median value. The difference between the median and the average value, or, as we may express it, the value M — A, becomes, therefore, a convenient indication of the direction and extent of the asymmetry of the curve of percentile distribution.

The interesting results which may be expected from an application of this method of discussion to the data already collected relating to the growth of children, will be presented in a future article.

An important feature in a table of percentile distribution, like Table 5, is found in the facility which it affords for determining the rank of an individual among others of the same class. Suppose, for instance, that a woman belonging to the class whose heights are given in the first line of Table 5, desires to know how her height compares with that of the other women measured. Suppose her height to be 160 centimeters. The table shows at once that this height exceeds

* Natural Inheritance, page 41.

that of 50 per cent., but does not exceed that of 60 per cent., of the women measured; and a simple sum in proportion shows that 160 centimeters corresponds to about 57.7 per cent. In other words, the woman in question, if ranked according to height, would stand about 577th in a group of 1,000 women selected at random.

Let us now consider what conclusions can be drawn from a comparison of the measurements described in this paper with those of other observers, as recorded in Table 5.

Height.

It will be observed, in the first place, that the heights recorded in the first line are slightly inferior to the corresponding measurements by Dr. Sargent, as given in line 2; while the figures in line 3, given by Mr. Galton as the result of his measurement of English women, are somewhat in excess of those obtained on this side of the Atlantic. In explanation of these differences, it may be said that the American measurements, having been taken upon women as young as sixteen or seventeen years, probably include a certain number who, being of slow growth, have not yet attained their full height; while the English measurements, being limited to women between twenty-three and fifty-one years, represent more accurately the adult height of the female portion of the community. It is also possible that we are dealing here with a difference of race, though the close correspondence which has been shown to exist between the heights of growing boys of the two nationalities does not support this view.

It is, furthermore, interesting to note that the difference between the heights at the fifth and the ninety-fifth percentiles is greater for the English than for the American women; being 21.5 centimeters for the former and 18.1 centimeters for the latter. It will be convenient to term this difference the *range* of the heights, though it of course indicates the range of only nine-tenths of the whole number of observations, the highest and lowest 5 per cent. being omitted. It will also be observed that the difference in height between the women of the two nationalities increases with tolerable regularity, as we ascend the series of percentile grades, from — 0.8 to 3.28 centimeters.

The slight excess of Dr. Sargent's measurements over our own is probably to be explained by the fact that the former were taken in schools frequented by the children of the most favored classes, while the latter include a certain number of individuals who had not grown up in the midst of comfortable surroundings.

Weight.

The weights given in the fourth line of Table 5 are seen to be considerably in excess of Dr. Sargent's figures in line 5, owing to the fact that the latter represent net weights, while our own observations were made upon women "in ordinary in-door clothing." The excess at most of the grades amounts to 3.3–4.0 kilograms (8–9 pounds), — a difference which corresponds very well to the weight of clothing of the older girls, as given in Table 25 of the article on the growth of children, already alluded to.

A more accurate comparison may be made between our own observations and those of Mr. Galton (line 6), since the latter were also made upon individuals in ordinary in-door clothing. It will be observed that the range of the weights is greater in American than in English women, there being between the fifth and the ninety-fifth percentile grades a difference of 24.1 kilograms for the American and 21.4 kilograms for the English women. It will be also noticed that at most of the percentile grades the weight of the American exceeds that of the English women, the difference being most marked in the highest percentiles. This observation, in connection with the one above noted with regard to heights, seems to show that there is little difference between the shortest as well as between the lightest women of the two nationalities; but that the tallest English women surpass the tallest American woman in height, while the heaviest American women exceed in weight the heaviest English women. Before this conclusion can be accepted as absolutely established, it will be necessary to determine how far the greater age of the English women has affected the result. In other words, we must ascertain more accurately than is at present possible, at what age the growth of women, both in height and weight, can be regarded as completed.

Sitting Height.

A comparison of the figures in the seventh and eighth lines of Table 5 shows that the ratio of the sitting height to the total height is somewhat greater in our measurements than in those of Dr. Sargent, the median value being 53.3 per cent. in the former, and 52.7 per cent. in the latter. This difference is doubtless associated with the superior height of the women measured by Dr. Sargent, in a manner which will be presently explained. For purposes of comparison, Dr. Sargent's measurements of the sitting height of men are given in the ninth line of Table 5; and it is interesting to notice that they are lower than the corresponding measurements of women at all the percentile grades. In other words, women appear to be relatively longer in the body and shorter in the legs than men. Whether this is a sexual peculiarity, or whether it depends upon the fact that men are, as a rule, taller than women, is a question which can be settled only by a comparison of the percentage sitting height of a large number of men and women of the same total height.* It is a good illustration of the readiness with which the card method of recording statistics lends itself to the solution of problems which may arise subsequently to their collection, that the data already on hand can be made to contribute to the settlement of the question thus suggested.

In the first place, in order to obtain a set of statistics as comparable as possible with those of Dr. Sargent, those observations only were selected for discussion which were made in schools and colleges on women of seventeen years of age and upwards. Ten hundred and fifty-eight cards were found to contain records of this sort. These cards were then sorted according to the height of the individuals, the measurements falling within each successive set of 5 centimeters being brought into a single group. The cards in each group were then sorted according to the percentage sitting height, as shown in Table 3, and the percentile distribution of the observations in each group calculated in the manner above described. The results of this calculation are given in Table 6.

* Ranke (Beiträge zur Anthropologie und Urgeschichte Bayerns VIII. 56) regards the relatively greater length of the body in women as a proof that the female sex stands embryologically on a lower level than the male.

TABLE 6.

Table Showing Percentile Distribution of Observations on Ratio of Sitting Height to Total Height in Women of Seventeen Years and upward, arranged in Groups according to Total Height.

	Height, Centimeters.	No. of Observations.	Values at Undermentioned Percentile Grades.										
			5	10	20	30	40	50	60	70	80	90	95
1	145–149	43	52.29	52.80	53.34	53.58	54.05	54.44	54.68	55.06	55.49	56.03	56.67
2	150–154	184	51.59	52.20	52.79	53.19	53.51	53.81	54.09	54.41	54.81	55.34	55.81
3	155–159	343	51.29	51.67	52.14	52.78	53.13	53.53	53.88	54.16	54.65	55.21	55.65
4	160–164	303	50.70	51.34	52.03	52.49	52.86	53.10	53.34	53.56	53.91	54.56	54.99
5	165–169	155	50.52	50.89	51.36	51.84	52.10	52.35	52.59	53.00	53.49	54.03	54.50
6	170–174	23	47.32	48.20	50.45	50.99	51.31	52.08	52.43	52.66	53.31	53.70	54.17

An examination of this table shows that the ratio of the sitting height to the total height at all the percentile grades decreases as the total height increases. In other words, tall women differ from short women less in the length of the body than in the length of the legs. That this is also true of men, there is no reason to doubt; but whether the ratio in question varies with the sex as well as with the height of the individual, is a question to be settled by a comparison of the values in Table 6 with those to be obtained by a similar discussion of Dr. Sargent's observations on men. In his dis-

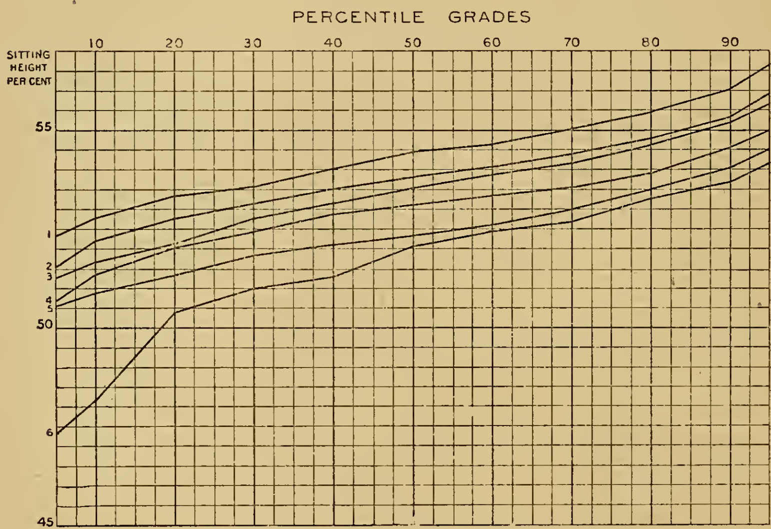

FIG. I. CURVES CONSTRUCTED FROM TABLE 6.

cussion of the anthropometrical differences between boys and girls, Dr. Sargent, in the above-mentioned article, points out that, at the age of fifteen years, boys are superior to girls in height, mainly on account of the greater length of the thigh bone. It would be of great interest to determine, by a further discussion of his observations in the manner above indicated, whether a disproportionate increase in the length of this portion of the body is mainly responsible for the differences in height between individuals of the same sex.

The way in which the ratio of the sitting height to the total height varies with the total height, may perhaps be

better understood from an examination of the curves in Fig. 1, which have been constructed from the figures in Table 6. The abscissas represent the successive percentile grades, and the ordinates the corresponding values of the ratio. It will be observed that the curves, which represent in order from above downward the values in the successive lines of the table, are in a general way parallel to each other; with the exception, however, of the lowest curve of all, which, being constructed from only twenty-three observations, is, of course, much less accurate than the others. These curves show very clearly, that, with an increase of height, is generally associated a relative diminution of the sitting height, and thus furnish a sufficient explanation of the fact above referred to, — that Dr. Sargent's measurements give a lower relative sitting height than our own. They show also, that, when the observations are arranged in groups according to the value of the total height, there is in each group a large range in the value of the relative sitting height; so that a certain number of women in the tallest group sit relatively higher than certain other women in the shortest group. For instance, a relative sitting height of 53.3 per cent. is surpassed by 20 per cent. of the women in the tallest group, while it is not reached by 20 per cent. of those in the shortest group.

Stretch of Arms.

It is popularly supposed that the distance between the finger tips when the arms are horizontally outstretched, is equal to the total height. An examination of the figures in the tenth, eleventh and twelfth lines of Table 5 shows that this is much more nearly true for women than for men; the median values in Dr. Sargent's observations being 100.8 per cent. for women, and 102.8 for men. Our own observations give at nearly all percentile grades slightly lower values than those of Dr. Sargent, — a difference which it seems reasonable to associate with the somewhat superior height of the women measured by Dr. Sargent; for, as we have just seen, tall individuals differ from short ones more in the length of the legs than in that of the body, and length of arms is generally associated with length of legs. A dis-

cussion, similar to that of the sitting height as above given, showing how the ratio of the arm-stretch to the height varies with the height, would, of course, settle the question; and a further discussion of Dr. Sargent's observations would also determine how far the superior ratio of the male sex is dependent upon a greater length of arms, and how far the greater breadth of the shoulders contributes to the result. In both sexes it will be observed there is a range of 7 or 8 per cent. between the fifth and ninety-fifth percentile grades.

It is evident that the data already on hand may be made to contribute to the solution of various questions connected with the physical development of the human race in Massachusetts; and that, with a further increase of the body of statistics, light will be thrown upon a variety of anthropological problems, especially those relating to the effect of race and environment on the physique of the individual. The systematic collection of such statistics in the public institutions of the State, would, in a few years, furnish data of inestimable value for the hygienist and the educator, as well as for the anthropologist and the statesman.

In conclusion, I desire to express my thanks to Miss Mary P. Nichols and to Miss Lucy R. Bowditch for much valuable assistance in the computation of tables.

THE

INFLUENZA EPIDEMIC OF 1889-90.

MAP OF
MASSACHUSETTS
SHOWING LOCATION OF
COUNTIES AND TOWNS,
TO ACCOMPANY ARTICLE ON
INFLUENZA.

THE INFLUENZA EPIDEMIC OF 1889-90.

By Samuel W. Abbott, M.D., *Secretary of the Board.*

The following investigation was undertaken under the general provisions of the Public Statutes, whereby the State Board of Health is required to make "inquiries in respect to the causes of disease, and especially of epidemics and the sources of mortality, and to gather such information in respect to those matters as it may deem proper for diffusion among the people."

The epidemic of influenza which prevailed so widely throughout many countries in 1889 and 1890 did not spare Massachusetts. Its effect upon the population of the State was so widespread, so decided and so general, that it was deemed by the State Board of Health a matter of sufficient importance to make it the subject of special inquiry, and to put on record such facts relative to its appearance in Massachusetts as could be gathered from physicians and others. A disease which, in the short space of six weeks, attacks three-fourths of a million of our population, carries off several thousands by death, and causes a loss to all classes of wage earners of several hundred thousand days' time by sickness, deserves more than a passing notice.

A brief historical sketch of the disease will first be presented, and this will be followed by a summary or compilation of the observations which have been collected from about 400 observers distributed throughout the State.

Influenza is an epidemic disease, characterized by catarrh of the respiratory and frequently of the digestive organs, by great and rapidly developed weakness, pains in the limbs, severe headache, serious nervous symptoms, and by fever of greater or less intensity (Zuelzer). It is distinguished from simple epidemic catarrh by its universal diffusion and often by the persistence and serious character of its sequelæ.

It spreads with great rapidity over wide tracts of country, including entire continents, and attacks a very large part of the population. It does not appear to be much influenced by atmospheric or meteorological conditions. It has appeared at different periods in all inhabited parts of the earth. "Its geographical distribution, in so far as we may trust the information before us, extends over the whole habitable globe" (Hirsch).*

History. — According to Parkes, epidemics occurred as early as 415 B.C., in the Athenian army in Sicily. Others are said to have occurred in Italy, France and Germany, in the ninth and tenth centuries. The descriptions of these early epidemics cannot be said to be satisfactory, and it is not until the fourteenth century that the records become fairly accurate and careful. In the fourteenth century six epidemics are recorded; in the fifteenth, seven; in the sixteenth, eleven; in the seventeenth, sixteen; in the eighteenth, eighteen; and in the nineteenth, eleven, up to the present date. Some of these have been very widely spread over the inhabited parts of the earth; such were those of 1311, 1557, 1580, 1590, 1729, 1732, 1762, 1775, 1780–82, 1830–32, 1817 and the present epidemic. In others it has been limited to comparatively small regions. Some of the most notable of these epidemics of recent centuries were those of 1580, 1729, 1732–33, 1782 and 1830.

The epidemic of 1580 spread from south-east to north-west over Asia, Africa and Europe. It came from Constantinople and Venice to Hungary and Germany, and thence to Norway, Sweden, Denmark and Russia. Its course was generally favorable; but in Rome and in Madrid it claimed its victims by thousands. In Saxony nearly four-fifths of the population were attacked.

The epidemic of 1729–30 was also very widespread. In five months it overran Russia, Poland, Hungary, Germany, Sweden and Denmark. In the autumn it reached England, France, Switzerland and Northern Italy. It reached Rome and Naples in February, and is said to have extended to Mexico. The principal manifestations were pain in the limbs, catarrh, oppression of the chest, hoarseness, cough,

* "Handbuch der Historisch-geographischen Pathologie," 1860, Vol. I.

and sometimes also cerebral symptoms, delirium, somnolence, attacks of faintness, etc. Petechial eruptions were also observed.

The epidemic of 1732–33 began in November, spreading from Saxony and Poland throughout Germany, Switzerland and Holland, and reached England in December. Thence it advanced in January to France, Italy and Spain, and across the Atlantic to North America, and thence southward to Central and South America.

One of the most remarkable of these extensive epidemics was that of 1782, which was said to have begun in Russia, although Noah Webster, in his "History of Epidemics," attributes its origin to America. In one day (Jan. 2, 1782) forty thousand people were taken ill with the disease (the temperature having fallen forty degrees in the preceding night).

In the present epidemic the course appears to have been mainly from east to west, beginning, as it did in Russia, about the last of October, it appeared in Germany and France in November, in the United States in December, and in South America in January, 1890.

The extent of different epidemics has varied greatly, in some cases several countries being visited by the disease, in others a more limited region, or even a single city or portion of a city. "No other disease has ever shown so pronounced a pandemic character as influenza" (Hirsch). The rapidity of its progress has also varied considerably, in some instances occupying but a few weeks in traversing a large part of the earth's surface, and in other instances several months. The epidemic of 1830-32 was about eight months in crossing from Russia to Germany. That of 1762 prevailed in Germany in February, in London in April, in France in July, and in America in October. With reference to its appearance on board ships at sea, Parkes says: "I cannot but consider that we require better evidence of ships being attacked in mid-ocean. In some of the quoted instances, the ship had been at a port either known to be infected, or in which influenza was really present, though it had not become epidemic. As we are ignorant of the exact period of incubation, some men may have been infected before sailing."

Hirsch details several noted instances of its appearance on board ships at sea. One of these is quoted from Chaumezière, in which "the disease appeared on board a French frigate in February, 1863, four days after leaving the harbor of Gorée in Senegambia, not a trace of the disease having shown itself in the town; while another ship of war, which left Gorée two days earlier and took the same course, arrived in the harbor of Brest without having had a single case of influenza on board." In other cases it is said to have occurred on board ships at the same time with its appearance on the land, such ships having had no communication with the shore. Hirsch also quotes the following: "Influenza appeared on the 'Monarch' while at sea on the passage from Payta to Valparaiso. She had left the former place on the 23d of August, and arrived at the latter on the last day of September. About the 12th of the month . . . seven men were placed on the sick list, with catarrhal symptoms, and during the following ten days upwards of eighty were added. . . . On the arrival of the ship at Valparaiso, the place was healthy; but, in the course of a few days, some cases of influenza made their appearance, and very soon afterwards the disease extended over the whole town. . . . The surgeon further observes that the whole coast, from Vancouver's Island southward to Valparaiso, was visited by the epidemic."

In a discussion of the Berlin Medical Society which is reported in the "Deutsche Medicinische Wochenschrift" for Jan. 23, 1890, Dr. Guttmann states, on the authority of Dr. Danguy, that the school-ship "La Bretagne," together with two other school-ships, lay in the harbor of Brest in December, 1889. An officer of the former ship returned to the ship from Paris with some goods, which he unpacked himself. This happened on shore at Brest. Three days after unpacking the goods he was attacked with influenza, while still at Brest (on December 11). On the following day his wife was attacked, and on the next day three servants. On the fourteenth, before he was well, he went on board the "Bretagne." On the sixteenth a case developed on board the ship, and from that day it continued to spread until 244 out of 850 were taken ill on board. It

also appeared in the families of those officers in the city of Brest who had been taken ill on board ship and had returned to their homes in the city. At the same time not a single case appeared upon the other school-ships in the same harbor, exposed to the same general climatic conditions. This case is very suggestive of the theory of communicability by human intercourse.

An impression having gained some credence that influenza had appeared on board the squadron of naval vessels which sailed from Boston in December, 1889, while on their course across the Atlantic and before their arrival in Europe, a letter was addressed by the writer to the Bureau of Medicine and Surgery of the United States Navy for information upon this point, to which a reply was received as follows: —

"The 'Chicago,' 'Boston,' 'Atlanta' and 'Yorktown' left Boston Dec. 7, 1889, for Lisbon, Portugal. The first three arrived at Lisbon on December 21 without having touched at any port *en route*. The 'Yorktown' arrived at that port December 23, having stopped about twenty-four hours at Fayal, Azores.

"The crews of all four vessels were attacked by the disease in the following percentage: 'Chicago,' 60 per cent.; 'Boston,' 27 per cent.; 'Atlanta,' 27 per cent.; 'Yorktown,' 26.1 per cent.

"Influenza first appeared on the 'Chicago' December 23, on the 'Boston' December 28, on the 'Atlanta' December 30, and on the 'Yorktown' December 28."

That influenza was prevailing severely in Lisbon at the date of arrival of this squadron is quite evident from the mortality reports of the city, which, though our files are incomplete, show that the death-rate followed the same course as prevailed in other cities during the epidemic, the figures being as follows: —

LISBON.

FOR WEEK ENDING—	Total Deaths.	Deaths from Bronchitis and Pneumonia.	Deaths from Phthisis.
Nov. 2, 1889,	133	16	21
Dec. 21, 1889,	189	36	27
Dec. 28, 1889,	207	33	18
Jan. 4, 1890,	301	86	36

Since 1847 there has been no pandemic of the disease, but it has prevailed in more or less limited areas, as at Paris in 1867, and also at Strasburg, and also more extensively in 1857–58. As an example of an epidemic having a decided local character, Dr. J. O. Webster gives the history of one which occurred in the National Military Asylum at Augusta, Me., in 1869.*

The number of inmates was about five hundred, of whom one-fourth were attacked, and a large part of these applied for treatment. The cases usually presented the following symptoms: *Prostration*, often so great as to require patients to take their beds. *Chills* with great sensibility to cold. *Headache* and frequently *vertigo*. *Fever*, apparently higher than that which is common in the early stages of typhoid. *Insomnia*, *anorexia* and *thirst*. *Cough and expectoration* in all cases. No physical signs were detected in the lungs where they had been previously healthy. The acute stage ran its course in from three to five days, and subsided gradually, leaving the patient weak and with an obstinate cough, which did not yield for weeks or months. Not every case presented all of these symptoms. There was every degree from very severe to light cases. They agreed in one characteristic, that the constitutional disturbance was primary and was out of proportion to the local catarrhal lesion. The epidemic ran its course in about a month, the epidemic influence growing weaker, the severer cases occurring in the first weeks of the epidemic. There were no fatal cases. There were a few cases of pneumonia and pleurisy, and in every case of phthisis the rational symptoms and the physical signs were greatly aggravated for a time. There had been no cases, either of pneumonia or of pleurisy, prior to this epidemic.

Dr. Webster states further that there was nothing in this epidemic which would give new light upon the *nature* or *cause* of influenza. Its character was confirmatory of the views already held, that it is a specific febrile affection; a general disease, of which the catarrhal lesions are only a local manifestation; a self-limited disease, running a definite course and not shortened by treatment.

The asylum is upon low ground, with fresh-water marsh near it. The inmates were soldiers of the late war, about one-half disabled by wounds, and the remainder suffering from chronic ailments. The weather had been rainy, but not unusually cold for the season, — late autumn.

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* "Boston Medical and Surgical Journal," 1871, Vol. 84, p. 377.

There was at the same time a prevalence of "colds" in the neighboring city of Augusta, five miles distant. These, however, lacked the severe constitutional symptoms which prevailed at the asylum.

Dr. F. E. Rand states that an epidemic of influenza visits the Caroline Islands in the tropics (lat. 7° N., long. 158° E.) twice a year, in January and August. That in January is the most severe in the dry trade-wind season. Similar epidemics are common in Marshall Islands.

The uncertainty as to the place of origin of the disease in former epidemics is quite remarkable. Parkes says of it: "Each nation in turn attributes to its neighbor, from whom it derived the disease, the unenviable honor of originating it. Thus the Italians have termed it the German disease; the Germans, the Russian pest; the Russians, the Chinese catarrh; and these names are indeed some evidence of its usual track. Noah Webster attributes its origin to different places in different epidemics, and several writers have fixed its origin in Chinese Tartary or in India.

No regular period of occurrence of the disease can be affirmed, although the older writers were wont to believe that it recurred in regular cycles. Reference to the chronological table published by Hirsch shows very clearly the irregularity of its recurrence. With reference to the direction of its spread, Hirsch states, as his conclusion from the data of many epidemics, "that the extension of the disease in one single direction cannot be regarded as a peculiarity pertaining to influenza." When the influenza visits a country or district composed of cities and of small towns, it usually attacks the cities or densely settled places first. The decline in any city is less rapid than its rise, and usually occupies from four to six weeks, or sometimes a longer period.

The symptoms in different epidemics resemble each other so closely that there can be no difficulty in recognizing it from the earlier descriptions; yet certain differences in its severity, in the character of the symptoms and in the comparative number of people attacked, have been noticed. In London, in 1847, it was estimated that two hundred and fifty thousand persons suffered; in Paris, from one-fourth

to one-half of the population; and in Geneva, not less than one-third.

Other Etiological Conditions.

Soil.—Influenza prevails upon every kind of soil or geological formation, and apparently equally upon all.

Volcanic Eruptions and Electrical Conditions.—No proof has been presented to show any connection of the disease with either of these conditions. Yet Noah Webster * collected a large amount of information, in which he endeavored to show that volcanic eruptions, as well as comets, were to be considered as playing an important part in its causation.

Season of the Year.—The disease appears and prevails at all times of the year.†

Temperature.—Nearly all observers agree in the belief that neither high nor low temperature, nor changes in temperature from high to low or the contrary, have any marked effect upon the disease. In a summary of conclusions upon this point by a society of Würtemberg physicians, in 1858, the following statement was made: "We are constrained to admit that influenza is altogether independent of weather conditions."‡ Moisture of the air, high or low barometric conditions, presence or absence of ozone, fogs, appear to have little or no influence on its prevalence.

Wind.—Its spread is apparently but little influenced by the wind, although instances have occurred in which the wind would appear to have favored its spread. It has also advanced against the wind.

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* "A brief history of Epidemic and Pestilential Diseases," by Noah Webster. Hartford, 1790.

† The opinion given by Hirsch appears to be that the season of the year has little or no influence upon the prevalence of influenza. In the chronological table which he presents, however, in which the date of its appearance in each country is stated where it is known, in most instances the month in which it prevailed in each country is stated, and in some instances the season only. If the ratio of the number of times in which it was prevalent in each month be compared with the sum of its prevalence in all the months, it will be found that the prevalence in the three winter months amounted to over thirty-six per cent. instead of twenty-five per cent. of the whole, while that of the summer was but sixteen per cent. If the dates of the time of outbreak of each epidemic are considered, excluding those years in which the epidemic of a previous year prevailed continuously into the following year, the same characteristic becomes evident in a still greater degree. Hirsch does not attach much importance to this point.

‡ "Würtemberg Med. Correspondenzblatt," 1858.

Human Intercourse. — Dr. Watson says, in his "Principles and Practice of Medicine": "The instances are very numerous, too numerous to be attributed to mere chance, in which the complaint has first broken out in those particular houses of a town at which travellers have arrived from infected places." Dr. Parkes also comments upon the frequency with which first cases have been introduced or imported, and also how often the townspeople nearest the invalids have been affected. Some of the earlier observers, especially Haygarth in 1775 and 1782, Falconer in 1802 and Baker in 1814, collected so many instances in support of this that they became convinced that its propagation was due entirely to human intercourse.* When once it had thus been introduced, it has afterward been developed with great rapidity, until a large part of the community has been attacked. This sudden invasion of a community makes it, to many persons, appear highly improbable that any effluvia passing off from the sick should thus so rapidly contaminate the atmosphere of a whole town.† In some cases, again, isolation or seclusion of a community, as in prisons, has given immunity; or at least that community has not been attacked. Dr. A. L. Mason‡ states that sixty-three cases came under his observation as occurring in groups in families. In six instances only were two persons attacked on the same day. The average interval between cases in the same household was four days. Sometimes a week or more elapsed. Whole families were never stricken at once.

Dr. Laurent of Rouen gives the following reasons for his belief in the contagious character of influenza: —

1. In the house and apartment which he occupied there was no appearance of influenza until after the arrival at the house, for consultation, of a dozen or more employees, upon the same afternoon, of a certain municipal department who were suffering with cough and the characteristic symptoms of influenza.

2. In his service at the Hotel Dieu, a certain number of

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* There were also several instances in Massachusetts, in the recent appearance of the disease, in support of the same opinion. (See p. 364 of this report.)

† Parkes, in "Reynolds' System of Medicine," Vol. 1, p. 35.

‡ "Boston Medical and Surgical Journal," Feb. 13, 1890.

patients under treatment for other diseases were not attacked until after the arrival of patients suffering with influenza.

3. There were other cases observed in the city where contagion was a manifest factor.

Incubative Period. — Since the infectious diseases generally agree in having a period of incubation, the presumption would be in favor of such a period in the case of influenza, if this is to be regarded as an infectious disease. Parkes says it is certain that such a period generally exists; that it is sometimes very short, and sometimes of many days' duration. Dr. Haygarth cites instances in which the incubative period was from a few hours to two or three days. He also mentions a few cases in which it would appear that a much longer time must have elapsed, — two or three weeks.

Protection from Second Attack. — There is but little if any evidence in support of the protective power of one attack to confer immunity against a second; and hence adults are not exempt, as they usually are in epidemics of scarlet-fever or other exanthemata; so that the proportion of adults to children attacked in an epidemic is necessarily greater than that which is observed in epidemics of other infectious diseases. During the recent epidemic several observations were reported of persons who were attacked twice within a period of a month or more.

Symptomatology. — The symptoms in influenza display a wide range, as shown by the following clear and concise classification given by Dr. F. C. Shattuck: * —

- General,
  - Prostration.
  - Pyrexia.
  - Pain,
    - Muscular.
    - Articular.
    - Neuralgic.
  - Insomnia.
- Cephalic,
  - Headache.
  - Coryza.
  - Pharyngitis.
  - Otitis.
  - Delirium.
- Respiratory,
  - Laryngitis,
  - Tracheitis,
  - Bronchitis,
    - Coarse
    - Capillary.
  - Complications,
    - Pleurisy.
    - Pneumonia.
- Abdominal,
  - Vomiting
  - Diarrhœa
  - Tenderness, simulating peritonitis.

* "Boston Medical and Surgical Journal," Feb. 13, 1890.

Relation to Other Epidemic Diseases. — The evidence in support of a connection between influenza and other epidemic diseases is not satisfactory, although a belief in such connection has often been affirmed. Instances in support of each position are to be found in the experience of different observers in the recent epidemic.

Relation to the Lower Animals. — Several species of lower animals have become affected in different epidemics prevailing among men; and epidemics of a disease resembling influenza have prevailed among horses, when they did not prevail among human beings. During the great horse epidemic of 1872, which bore a strong resemblance to influenza, the disease was not unusually prevalent among men except in a few limited localities; while other infectious diseases, such as small-pox, measles, scarlet-fever and cholera infantum, were unusually prevalent in that year.

Nature of the Exciting Causes. — After an unsatisfactory discussion of this point, Dr. Parkes concludes that "it is impossible, at present, to come to any conclusion as to the nature of the cause." He also states, in an earlier part of his monograph, while referring to the uncertainty of the data obtained in consequence of the limited intercourse between nations, "The next epidemic will give more reliable information than any of the former."

Some of the earlier writers appear to have held a decided belief in the production of influenza through the medium of an insect which infected the air; among them was the philosopher Kant. Biermer (1865) calls attention to the probability of a specific principle, developed from time to time in high latitudes, from which it travels to other countries; and suggests that the apparent contradictions of rapid diffusion and slow migration, of general extension and local limitation, of the disease, could be easily explained upon the theory of a *living miasm*, having an independent existence, which would find in certain places conditions which would be more favorable to its existence than in others.*

Seifert of Würzburg describes micro-organisms which he has found in the expectoration of patients suffering with influenza, to which he attributes the spread of the disease.

* Zuelzer, in "Ziemssen's Practice," Vol. 2, 1875.

They were mostly arranged in long chains, and in rare cases connected two by two, and frequently isolated from each other. They were invariably in the gelatinous clots. Experiments in inoculation resulted in failure. He did not find them in the sputa of ordinary bronchial catarrh. More recently Weichselbaum has found in the nasal mucus of such patients a micrococcus similar to that of pneumonococcus. Gilles of Vienna made examinations, with similar results. Streptococci are reported as having been found in the blood and expectoration of "grippal" patients by Drs. Vaillard, Vincent, du Cazal, Bouchard and others.

Dr. Prudden* of New York examined by the current bacteriological methods seven cases of epidemic influenza and six cases associated with pneumonia, and concludes as follows: —

If we sum up the whole series of examinations, we find that in the secretions from seven cases of simple influenza no special new forms of bacteria were discovered which there is reason to believe have anything to do with causing the disease. The only pathogenic species which were found were the well-known pyogenic bacteria, Staphylococcus pyogenes aureus, Streptococcus pyogenes (in four of the cases), and the diplococcus pneumoniæ (in one of the cases). In the pneumonia following the influenza (six cases), we also found no special new forms of bacteria, but the same pyogenic forms (in five of the cases) and the diplococcus pneumoniæ (five cases).

Thus, while we gain no positive new light in the etiology of epidemic influenza in this series of examinations, we are able, from the results of the studies on the pneumonia which accompanies it, to establish the probability that the pneumonia, although apt to be irregular in its course and atypical in its morphology, is usually due to the same bacterial agency as is at work in the ordinary acute lobar pneumonia. How much this may be further complicated by the frequent presence of the pyogenic bacteria, is a question which must be settled by further studies on the general relationship of these organisms to inflammations of the respiratory organs and to other mucous membranes.

It would seem from these studies, furthermore, that the relationship of the influenza to the pneumonia is that of a predisposing factor only; a conclusion, indeed, toward which clinical investigations have been already led by a different line of observations.

It would seem that the influenza, with its tendency to an

involvement of the respiratory passages, furnishes, not indeed the common, but an analogous, predisposing condition, leading to an atypical pneumonia. This form of predisposition seems to be, in many respects, similar to that which measles furnishes in children to the incursions of varying forms of pulmonary inflammation, whose determining etiological factors have not yet been sufficiently studied.

We simply learn that, in these few cases, the use of the culture methods and media commonly employed in the study of bacteria and allied forms of micro-organisms has brought to light no living germ which there is reason to believe has anything to do with causing the disease. But this negative result should leave us entirely unprejudiced toward any other series of observations which, with more abundant material and a more refined or favorably applied technique, may promise a solution of the problem.

Dr. Prudden further calls attention to the studies of Dr. Ribbert of Bonn upon five cases of influenza, two without and three with pneumonia, in which the only constant species found was the streptococcus pyogenes. He lays stress on the probable importance of this species in inducing the various complications.

The following brief résumé upon this branch of the subject is given by Dr Ribbert, in an article in the "Deutsche Medicinische Wochenschrift" of April 10, 1890, entitled, "Further Bacteriological Communications on Influenza": —

The numerous investigations on the etiology of influenza, published recently (in the last few months), have not led to the discovery of a specific excitant, and hence remain unsatisfactory, as they did not arrive at congruent results. There have been found in the sputum of the patient, in the inflammatory products of the respiratory mucous membrane taken post mortem in the pneumonic and pleuritic processes, sometimes the streptococcus pyogenes, then the diplococcus pneumoniæ, and finally forms which, although they were similar to the last two varieties of cocci, yet in some points they differed. Staphylococci were also found, but quite rarely, and in numbers which were limited. The streptococcus pyogenes was proved to be present by the larger number of observers. Besides me,[1] Finkler,[2] Laveran,[3] Vaillard,[3] du Cazal,[3]

[1] "Deutsch. Med. Wochenschr.," No. 4, 1890. [2] Ibid, No. 5, 1890.
[3] "Le Bulletin Médicale," No. 8, 1890.

Bouchard[1] and Löffler, in a case communicated by Mosler,[2] have cultivated it. Leyden[3] observed it in a number of his patients, of whom two especially distinctly presented the picture of the streptococci pneumoniæ, which has been so fully described by Finkler, Prudden[4] found it in one-half of his cases; Netter,[5] on the contrary, in but few; Klebs,[6] who has chiefly made communications on the presence of ciliated monads in the blood, remarked it (post mortem) in one of two cases with pneumonic infiltrates; Babes[7] states that the streptococcus appears quite frequently in the sequelæ of influenza. Weichselbaum[8] only found it once; but, in his very numerous investigations, he, however, on the contrary, proved the presence of the diplococcus pneumoniæ, which also Levy[9] found in a series of observations. Jaccoud[10] could demonstrate it also in the sputum of twelve pneumonia patients, twice in company with the streptococcus; in numerous other cases, however, which ran on without a distinct pneumonia, it was not seen. Netter and Duflocq[11] obtained the diplococcus as the more frequent result of the attempts at culture; Leyden and Prudden saw it several times; Klebs in one case. Whether the observations communicated by See and Bordas[12] belong here is doubtful, as they expressly speak of fibrinous or lobar pneumonias, as sequelæ of the grippe, in which the diplococcus was found. Marmorek[13] and Kirchner[14] have described peculiar forms of cocci. The former found chain-cocci, which distinguished themselves from the diplococcus pneumoniæ by a somewhat more luxuriant growth and a lack of virulence, and differed from the streptococcus by not growing upon gelatine. Kirchner reports upon a form of coccus which differs in some points from both the microbes mentioned, in that it lacked pathogenic properties, and could not be colored by Gram's method. Jolles[15] cultivated from the sputum and urine of influenza patients a capsule-shaped bacillus very similar to Friedländer's pneumonia bacillus.

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1 "Semaine Médicale," No. 5, 1890.
2 "Deutsch. Med. Wochenschr.," No. 8, 1890.
3 "Berl. Klin. Wochenschr.," No. 10, 1890.
4 "Medical Record," Feb. 15, 1890.
5 "Le Bulletin Médicale," No. 8, 1890.
6 "Centralbl. f. Bacteriologie," VII., No. 5.
7 "Centralbl. f. Bacteriologie," No. 8.
8 "Wien. Klin. Wochenschr.," Nos. 6-10, 1890.
9 "Berl. Klin. Wochenschr.," No. 7, 1890.
10 "Semaine Médicale," No. 7, 1890.
11 "Revue de Méd.," No. 2, 1890.
12 "Comptes Rendus," CX., p. 197.
13 "Wiener Klin. Wochenschr.," No. 9, 1890.
14 "Centralbl. f. Bacteriologie," VII., No. 12.
15 "Wiener Med. Blätter," No. 4, 1890.

Predisposing or Internal Causes. — Epidemics attack the people with but little regard to age, race, sex, constitution or condition in life. Parkes states that the female sex appears to be slightly more liable, a statement which is not supported by the observers reporting in the present epidemic in Massachusetts. Young children were also more exempt in the latter instance than adults. In certain observations made by Schleisner in Iceland, it appears that the natives only were attacked.

Diagnosis. — Cases of epidemic influenza occurring during the progress of an epidemic are not likely to be confounded with other diseases. It may resemble the initiatory stages of typhoid fever; but the peculiarities of the temperature changes in the latter, the rose spots, the longer continuance of the disease, will serve to distinguish it from influenza. It would be more difficult to distinguish it from ordinary catarrhal fever. The latter does not spread from one country to the other, and is not followed by the intense prostration of epidemic influenza. Parkes states that, during the prevalence of influenza, many other diseases, such as bronchitis and typhoid fever, are called influenza, and hence may give rise to the opinion that during the epidemic of influenza such diseases diminish in frequency and reappear at its close.

The earlier writers say but little about the differentiation of influenza from dengue, but in the recent epidemic the question has frequently arisen; and, while cases of the latter disease bear some resemblance to cases of influenza in which severe nervous symptoms predominate, the general opinion appears to be in favor of a decided distinction between the two diseases. Dengue has always been confined to a more limited territory, and prevails almost exclusively in warm climates; while influenza spreads rapidly and through all countries. Dengue is usually characterized by more severe pain in the joints, and also by swelling in the joints, and often by the presence of an eruption. The temperature is often as high as 106°–107° in dengue, but rarely above 105° in influenza.

Sequelæ. — Pneumonia and bronchitis appear to be the most common concomitant diseases, as shown by the experi-

ence of the recent epidemic. Dr. Guiteras of New York, writing on Jan. 14, 1890, says: "During the height of the epidemic, lobar pneumonia was the most frequent and deadly. At present date, however, lobular pneumonia and bronchitis of the smaller tubes and capillaries are more frequent; and although they are not as fatal, comparatively, have nevertheless caused many deaths."

The Epidemic of 1889–90.

The epidemic of the past season was first announced as having appeared in northern Russia early in October, 1889. It was first noticed in St. Petersburg, in the last week of that month, in those parts of the city known as Wassili-Ostrow and Kolomna, whence it rapidly spread throughout the city.* The hospitals were soon filled, and the number of persons attacked was estimated at one-third to one-half of the population. All classes, ages, sexes and conditions were affected alike; schools were closed, some of the factories ceased work, and many physicians were too ill to visit their patients. Observations attributed about two days to the incubative period. The preliminary symptoms of headache, chills and malaise, were of short duration. The fever rapidly increased, the temperature rising to 104° or 105° F. (40°–40.5° C.) in the first day, and then falling off in the second day. The fever usually lasted from three to six days; seldom more than six. There was enlargement of the spleen. The symptoms were divided into nervous, catarrhal and gastric; and in a few cases there were eruptions of herpes, erythema, etc. It appeared in the following month in Paris, Vienna and Berlin, and in December in London, with identical symptoms.

The following brief statistical data are presented for the purpose of showing the increase in mortality during the prevalence of the epidemic in some of the larger cities of Europe, as compared with the figures of the previous year. In Paris, according to Dr. E. Vallin,† the total number of deaths during the season of the epidemic was as follows, the

* "Medicinische Wochenschrift," No. 46, St. Petersburg, Nov. 30, 1889.
† "Revue d'hygiène," January, 1890.

numbers for the same weeks of the preceding year being also given for the sake of comparison: —

WEEK.	1888-89.	1889-90.
December 1- 7,	942	1,091
8-14,	984	1,188
9-21,	985	1,626
22-28,	1,033	2,374
29-January 4,	970	2,716
January 5-11,	946	2,078
12-18,	–	1,493

The number of deaths in Paris from acute diseases of the respiratory organs for the first week of 1890 was 977, as compared with 155 for the corresponding week of 1889. From phthisis the deaths in the first week of 1890 were 465, as compared with 169 in the same period of 1889.

The daily number of deaths in Paris during the brief reign of the epidemic was 380, instead of 124 in the previous year. During the severe epidemic of cholera in Paris in 1865 the maximum of deaths in a day was 235 in a population of 1,800,000, which was equivalent to 340 deaths for the present population.

The deaths in Paris from pneumonia, broncho-pneumonia and acute bronchitis, for the first two weeks of 1889 and and 1890, by age-periods, were as follows. The greater excess in the older age periods is very manifest in this table: —

AGES.	First two weeks.	
	1889.	1890.
0- 4 years,	45	111
5-19 "	6	22
20-39 "	7	127
40-59 "	14	249
Over 60 "	35	290
	107	799

The deaths from pneumonia in Paris had increased from 67 in the forty-ninth week of 1889 to 355 in the fifty-second week. Those from broncho-pneumonia increased from 34 to 138, those from acute bronchitis from 60 to 134, those from chronic bronchitis from 46 to 131, and those from phthisis from 206 to 430. The number of deaths of males from phthisis was more than double that of the females.

Other chronic maladies were increased as follows : —

Heart diseases, from 61 to 122.

Apoplexy and paralysis, from 52 to 81.

Diabetes, from 6 to 18.

Cirrhosis of liver, from 7 to 12.

Bright's disease, from 11 to 25.

There was also a slight increase in the mortality from whooping cough and measles.

Deaths by Sex and by Age, Paris, 1889.

AGE PERIODS.	Fifty-first Week, 1889.		Fifty-second Week, 1889.	
	Males.	Females.	Males.	Females.
From 0 to 19 years, . . .	200	179	236	223
From 20 to 59 years, . . .	485	260	798	417
Sixty years and over, . . .	215	287	322	378
	900	726	1,356	1,018
	1,626		2,374	

By which it appears that among children the mortality of boys was a little greater than that of girls. Among adults the mortality of males was twice that of females. Among the aged, the mortality of females was slightly greater than that of men.

The number attacked with influenza in the epidemic in Paris was estimated at 300,000.

In Berlin the deaths from phthisis increased from 97 in the week ending Nov. 30, 1889, to 182 in the week ending Dec. 28, 1889 ; or nearly 100 per cent.

In London the increased mortality from phthisis was very great, the deaths from this cause for the three weeks ending with January 11, 18 and 25 were respectively 267, 312 and 239 as compared with 187, 136 and 152 in the corresponding weeks of the previous winter.

Dr. Bertillon mentions the fact that the term "grippe," or "influenza," does not appear in the earlier mortality lists; a fact which is also true of the reports of London and other cities. The figures for London were as follows: —

Deaths Certified as from Influenza for the Successive Weeks ending —

Jan. 4, 1890,	4
Jan. 11, 1890,	67
Jan. 18, 1890,	127
Jan. 25, 1890,	105
Feb. 1, 1890,	75
Feb. 8, 1890,	38
Feb. 15, 1890,	30
Feb. 22, 1890,	24
March 1, 1890,	23
March 8, 1890,	11

The statement already made that the increase in the mortality from phthisis would be found to be partially balanced by a decrease from this cause later in this season is borne out by the experience of London; for, while in London the mortality from respiratory diseases still remained largely increased during May and the earlier part of June, the deaths from phthisis were somewhat diminished.

The data are as follows: —

Deaths from respiratory diseases in London for seven weeks ending June 14, 1890,	1,949
Deaths from respiratory diseases in London for seven weeks ending June 15, 1889,	1,385
Deaths from phthisis in London for the seven weeks ending June 14, 1890,	945
Deaths from phthisis in London for the seven weeks ending June 15, 1889,	1,033

In Amsterdam, in the three weeks of 1889, there were respectively 168, 280 and 80 deaths in excess of the corresponding weeks of 1888.*

* "Algemeen Handelsblad," Amsterdam, Feb. 5, 1890.

Rouen. — Daily Number of Deaths for First Fortnight of January, 1889-90.*

	1889.	1890.
January 1,	10	17
2,	12	15
3,	11	13
4,	9	12
5,	10	16
6,	3	17
7,	8	18
8,	17	36
9,	6	33
10,	9	25
11,	8	30
12,	16	20
13,	11	16
14,	18	22
	148	296

Further statistics of European cities may be found in the appendix. (Table I.)

The Epidemic as it appeared in Massachusetts in 1889–90.

For the past forty-five years or more, or during the period of registration which began with the year 1842, no epidemic of influenza has prevailed within the State to such an extent as to have manifested itself in any serious manner in the annual lists of deaths. An examination of the registration reports for each year since 1842 shows that in no year were recorded more than 100 deaths from this cause; the highest number from influenza in a single year (92) occurred in 1857, and the least number (8) in 1884. The average annual number of deaths from this cause reported in the State for the period 1842 to 1888 was 38. The average

* Report of United States Consul, Jan. 15, 1890.

number during the first half of this period was greater than that of the last half, especially when considered with reference to the increase of population. From these statistics of non-epidemic influenza between the years 1842 and 1888 it appears that its greatest prevalence, or rather the years in which the mortality from this cause was greatest, were also years of unusual mortality from pneumonia, and in some instances from bronchitis.

These figures have but little significance or bearing upon the recent epidemic, since, so far as we can learn, there was no epidemic of influenza during the entire period of registration since 1842, within the limits of Massachusetts, which could compare in intensity with that which prevailed in the winter of 1889–90.

In the early history of Massachusetts, it appears that influenza occasionally prevailed. In 1647, according to Gov. Winthrop,* "a malignant fever prevailed, and an epidemic influenza passed through the whole country and universally affected the colonists and natives; but it was not very mortal. Wherein a special providence of God appeared: for, not a family nor but few persons escaping it, our hay and corn had to be lost for want of help; but such was the mercy of God to his people as few died, — not above forty or fifty in Massachusetts and near as many at Connecticut."

In 1655, another epidemic distemper, similar to that of 1647, passed through New England. It began in June, and few persons escaped.

In 1697–98 the influenza began in November, and prevailed till February in Massachusetts. Whole families and whole towns were seized at the same time. In the same year a "mortal disease prevailed so much in Fairfield, Conn., that well persons were not found to take care of the sick and bury the dead. Seventy died in three months out of a population of less than one thousand.†

The spread of the recent epidemic throughout the continent of Europe, and the natural supposition that it might soon visit America, thus following the history of previous

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* Winthrop's Journal, Vol. II., p. 310.

† Report of Sanitary Commission of Massachusetts, 1850, p. 63.

epidemics, undoubtedly led many to be more or less watchful for its appearance, and possibly some of the earlier cases reported may have been of the same character with the ordinary influenza which prevails to a greater or less degree in almost every winter season, and which apparently have a relation to epidemic influenza similar to that which cholera-morbus bears to Asiatic cholera.

The meteorological conditions which prevailed in Massachusetts during the winter were not exceptional as compared with those of other portions of the country. The season was milder than the average winters of New England. The following data are taken from the reports of the New England Meteorological Society for the months of November and December, 1889, and January and February, 1890: —

Barometer.

	Inches.
Monthly mean for November, 1889,	30.30
for December, 1889,	30.11
for January, 1890,	30.16
for February, 1890,	30.08

Temperature.

		Mean for Ten Years.
Monthly mean, November, 1889,	41.1° F.	–
December, 1889,	33.8° F.	27.5° F.
January, 1890,	28.6° F.	23.7° F.
February, 1890,	30.3° F.	24.9° F.

Rainfall.

	Inches.	Mean for Ten Years.
November, 1889,	6.12	–
December, 1889,	3.09	3.55
January, 1890,	2.97	4.01
February, 1890,	3.59	3.72

Prevailing Wind.

November, 1889,	West.
December, 1889,	North-west.
January, 1890,	North-west.
February, 1890,	North-west.

The number of observers contributing to these observations of temperature, rainfall, etc., in Massachusetts during the period in question was about sixty, distributed throughout the whole State.

The daily press of our large cities can undoubtedly be trusted for its records of the date of passing events.

In the New York papers of Dec. 18, 19 and 20, 1889, appears the first definite mention of the appearance of influenza upon this side of the Atlantic. Dr. R. Guiteras of New York city reports to the Board of Health of that city, on December 17, seven cases which had come under his observation in a German family of thirteen persons, the first case being that of a young woman, aged 25, who was taken ill on the 11th of December. Mention is made of her having received a letter from Berlin on the 10th of December. Other cases followed in the same family as follows: One on the 12th of December, one on the 13th, two on the 14th and two on the 15th, their ages varying from four to fifty years. The symptoms named were sudden chills, malaria, prostration, headache, acute coryza, pharyngitis, laryngitis and bronchitis, a temperature of 100° to 105° F., voice nasal, congestion of mucous membrane of the mouth and eyes.

In "The New York Times" of December 19, mention is made of the influenza having appeared at Buffalo on December 18. It is also recorded at Detroit, December 19 (bank employees being the first persons attacked). One hundred cases are reported at Kansas City, December 19. It is also reported at Rochester, N. Y., December 20, among post-office employees, and at Kingston, N. Y., on the same date.

In the daily papers of Boston it is mentioned as being at Charles Street Jail, where a dozen of the inmates were attacked December 17, as reported by the city physician, Dr. McCollom.* Cases were also reported from the

* 18th Report of Boston Board of Health, p. 75.

Charlestown, Roxbury and Dorchester districts on the same day. Twenty men were reported as ill, employed in a manufacturing establishment at Cambridge, and eleven patrolmen of Division 4 of Boston on the same day. Its general appearance among large numbers of people in Boston was quite as early, if not a day or two earlier, than in New York.

The promptness with which the circulars of the Board were issued had the decided advantage of reaching the individuals to whom the circulars were addressed at a time when the epidemic was still in progress. Greater accuracy was thus secured, since the data relative to the epidemic were noted by the observers very nearly at the time of their occurrence, when they could scarcely be said to require an effort of the memory to recall them. This advantage was demonstrated by the fact that the few returns which were received quite late in the season lacked the quality of accuracy in proportion to the length of time which had elapsed since the date of the epidemic.

There was, on the other hand, a disadvantage in issuing the circulars at so early a date, in that information relative to the mortality which was due to the disease could not be regarded as complete until the cessation of the epidemic. This information, however, was supplied by later correspondence with boards of health and registrars of cities.

The actual mortality rate from influenza is not so easily ascertained as that of many other diseases in which the question is uncomplicated, as for example the acute exanthemata.

The actual number of *deaths*, as certified by physicians to be due directly to influenza, is found to be small when compared with the whole number of persons taken ill with influenza in a given community. A great number of deaths which were certified as from "pneumonia" and "bronchitis" were undoubtedly those of persons who had succumbed to the epidemic of influenza, the disease having assumed these forms or complications, or, in other words, the influenza had induced in them a condition which made them susceptible to pneumonia or bronchitis. The mortality from phthisis and other chronic wasting diseases was also

increased in the same period, but the same conclusions do not apply to this class of diseases as to pneumonia and bronchitis, since the deaths from phthisis were mainly among enfeebled persons, whose deaths were only hastened, but not necessarily caused, by the influenza. These persons would probably have died at a later period from phthisis. So that the death rate from this cause, which is usually distributed throughout the year with considerable uniformity, was distorted, the number of deaths from phthisis in the winter months being unusually increased, to be followed by a corresponding decrease later in the year. This fact is corroborated by the experience of some of the larger life insurance companies to which reference is elsewhere made.

In the tables and diagrams given in the appendix are presented the numbers of deaths, together with the mortality rates, as compared with the living population in several of the principal European cities having a total population of about twelve and a half millions, for the period beginning with the first week of November, 1889, and ending with the last week of January, 1890; a period covering the time from the outbreak of the epidemic in Russia until its disappearance as an epidemic. The tables present the total mortality, the deaths from bronchitis and pneumonia, as well as the progress and decline of the epidemic. These are shown in such a manner that its periods of greatest incidence upon the population in each city may be compared.

In Table I. the cities are arranged with reference to their longitude, and the maximum mortality is expressed in bold-faced type. This arrangement shows a general progression in the order of greatest fatality from northern Russia toward the west, and also in a less notable degree from north to south. The greatest mortality at Stockholm occurred three weeks later than at St. Petersburg. That of Berlin occurred a week later than that at Stockholm; that of Paris a week later than that of Berlin, and that of London a week later than that of Paris, while that of Dublin occurred three weeks later than that of London, and also later than that of Boston and New York. There are some notable exceptions, as in the case of Königsberg, while in some instances the greatest

mortality from bronchitis and pneumonia did not coincide in time with the highest mortality from all causes.

The sources from which these data are obtained are in the case of London, the weekly reports of the registrar-general's office; in that of Berlin, those of the statistical office (Statistisches Amt.); and in the case of the other European cities the data are mostly derived from Dr. Janssen's excellent reports contained in the weekly returns of the city of Brussels. To these have been added such data as could be obtained from the health officers of the principal cities of the United States, comprising a total population of about 5,000,000, and finally the returns of the larger cities of Massachusetts, having a total population of about 900,000.

In the returns from cities of the United States the data of the corresponding period of the previous year are also presented for comparison.

While the mortality rate of the epidemic period was notably increased, and especially that of diseases of the respiratory organs, and also among persons already suffering from phthisis and other wasting diseases, who were too weak to withstand the depressing effect of a severe attack of influenza, a partial counter-balance is found to take place in the ensuing months in consequence of the fact that the deaths of a considerable portion of this enfeebled class were hastened, thus swelling the mortality of the winter months, while that of the ensuing months of the year from the same causes (phthisis, etc.) was somewhat lessened, but not in the same ratio. This is found to be the case in some of the principal cities the records of which have been compared.*

Sources of Information.

For the purpose of obtaining as complete a record of the recent epidemic as possible, so far as it was manifested in Massachusetts, it was deemed best to collect information from sources uniformly distributed throughout the State, with a fair degree of regard to the density of the population.

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* See statistics relative to London on page 325.

The persons from whom information was sought were: —

First. Physicians in general practice, whose daily contact with the people and correct training in methods of observation, and especially with those who were victims of influenza, would render their own personal observations of special value.

Second. The superintendents of public institutions, who would have special opportunity for observation of the effects of the epidemic upon the persons under their immediate charge. The greater number of these superintendents are physicians.

Third. The superintendents of factories, mills, corporations and other establishments employing large numbers of persons. To these were added the banks, since a statement had become current that the epidemic made its appearance first in those institutions.

Fourth. The records of the Boards of Health of the cities.

The circular to physicians contained the following inquiries: —

1. What was the date of first appearance of the epidemic in your neighborhood?
2. In what week was it most prevalent?
3. What estimated proportion or percentage of the population in your community was attacked?
4. What ages or periods of life were most affected?
5. Which sex was affected most severely?
6. What was the average duration of the attack?
7. What symptoms predominated in the cases under your observation?
8. What other diseases were increased in frequency or severity simultaneously with the epidemic of influenza?

The questions to which answers were requested in the circulars addressed to employers in factories and other large establishments differed somewhat from those addressed to physicians, for obvious reasons. Questions 1, 2 and 5, relative to the date of first appearance of the epidemic, week of its greatest prevalence, and the sex most severely affected, were repeated in this circular, the remaining ques-

tions being omitted and the following inserted in place of them : —

3. What estimated proportion or percentage of the persons employed by you were attacked?

4. What proportion or percentage were obliged to leave their work in consequence of such illness?

5. What was the average length of absence from work (in days)?

The circulars addressed to physicians were sent to 400 physicians in active practice, and were distributed throughout the State in fair proportion to the distribution of the population. The ratio of replies received as compared with the circulars issued was unusually large.

The sources of the replies which were returned were as follows, by counties : —

From Barnstable County,	15
Berkshire County,	18
Bristol County,	7
Dukes County,	4
Essex County,	22
Franklin County,	5
Hampden County,	14
Hampshire County,	11
Middlesex County,	29
Nantucket County,	5
Norfolk County,	14
Plymouth County,	5
Suffolk County,	28
Worcester County,	17
Total,	194

In addition to these the same circular was also sent to the superintendents of 25 of the largest public institutions in the State, in the belief that accurate information could be obtained from them, since the inmates of these institutions were more directly under observation than patients in private practice and the general population at large. Replies were received from 24 institutions, including eight lunatic hospitals, four general hospitals, the State almshouse, workhouse, industrial school for girls, reform school for boys, primary school, four prisons and houses of correction, and

two United States marine hospitals and one asylum for nervous diseases.

The circulars to employers and superintendents of large establishments were sent to most of such corporations throughout the State, and replies were received from the following industries and establishments : —

Cotton mills and similar industries,	33	Tanneries,	2
Woollen, carpet and worsted mills,	21	Xylonite (celluloid),	1
Boot and shoe factories,	18	Glass factory,	1
Twine and thread factories,	3	Tack factory,	1
Linen mills,	2	Watch factory,	1
Silk factories,	6	Cutlery works,	1
Rubber and rubber fabrics,	2	Axe factory,	1
Paper mills,	5	Rattan ware,	1
Print works,	2	Straw works,	1
Machine shops,	6	Optical works,	1
Locomotive works,	1	Printing house,	1
Car manufactory,	1	Boston Gas Light Co.,	1
Organ manufactory,	1	Building Construction Company,	1

Replies were also received from the Boston Post Office, employing 925 persons; from six large dry and fancy goods establishments in Boston, employing about 7,500 persons; and from 22 banks in different cities in the State.

The greater number of the circulars was issued on the 22d of January, while the influenza was still prevalent but had begun to decline. A smaller number was also issued early in February for the purpose of making a more equal distribution, and also to elicit information from certain localities in which peculiar conditions appeared to prevail. The circulars to employers were issued February 1. The total number of replies received was as follows : —

From physicians in general practice,	194
Superintendents of public institutions,	24
Factories, mills, banks and other establishments,	178
Total,	396

Of the replies from physicians and public institutions, 127 were received before February 1, 73 in February, 14 in

March and 4 in April. Of those from employers, etc., 165 were received in February and 13 in March.

The number of cities and towns from which they were received was 140, including 22 out of the 25 cities. The general population of the State to the greater part of which these observations extended was about 2,190,000 at the time of the report. That of the public institutions returning replies was 8,750, and that of the industrial and other establishments was 74,698 or about one-tenth of the wage-earners employed in different industries and occupations in the State.

Analysis of the Replies.

Question 1 (both circulars). — *Date of first appearance of the epidemic.*

To this inquiry there were received 356 replies, and for convenience of classification the dates may be divided into periods as follows: —

	Replies from Physicians.		From Public Institutions.		From Employers.		Total.	
	Number of Replies.	Percentage.	Number of Replies.	Percentage.	Number of Replies.	Percentage.	Number of Replies.	Percentage.
(a) Dates before Dec. 1, 1889,	23	12	-	-	2	15	25	7
(b) Dates from December 1 to December 14, inclusive (2 weeks),	34	18	-	-	13	9	47	14
(c) Dates from December 15 to December 21, inclusive (1 week),	67	36	8	36	30	21	105	29
(d) Dates from December 22 to December 28, inclusive (1 week),	31	16	9	41	30	21	70	20
(e) Dates subsequent to December 28, inclusive,	34	18	5	23	70	48	109	30
Aggregate,	189	100	22	100	147	100	356	100

An examination of the foregoing table shows that out of 189 physicians, whose observations extended mainly to the general population, 67, or 36 per cent., state a definite date for the appearance of the epidemic in the week ending Dec. 21, 1889, while 57, or 30 per cent., give a date before, and 65, or 34 per cent., after that week. All of the replies from public institutions specify dates later than December 16. Of the replies from employers, which relate chiefly to persons employed in in-door occupations, 21 per cent. specified a date of first appearance within the week ending December 21, 10 per cent. before that date and 69 per cent. afterward.

Fifty replies out of the whole number, or 15 per cent., specified the 20th and 21st of December.

Allowance should be made for 8 per cent. of the replies, which were stated more or less indefinitely. These related either to the earlier or later weeks of the period in question, and were stated in such terms as "about the last of November," "first of December," "about Christmas," "about January 1," etc. There was also noticeable a tendency to the accumulation or clustering of reports about special dates, as: December 10, 8 replies; December 20, 42 replies; December 25, 21 replies; and January 1, or about January 1, 19 replies, — an observation which is not of uncommon occurrence in any statistical inquiry in which dates are sought for.

The average date of the replies from physicians was a few days earlier than the average date of those from employers and others.

The following extracts are made from the circulars having reference to definite dates, and to other points bearing upon the question of the time of the first appearance of the epidemic.

"Was taken ill myself Nov. 25, 1889." — *Medford.*

"Saw one case as early as November 27. Did not recognize it at the time. Other cases the last week in December."— *Pittsfield.*

"Scattering cases the last week in November."— *Taunton.*

"Probable cases in last week of November; 'epidemic' after December 15." — *Boston.*

"Dec. 14, 1889. A severe case; rapid recovery." — *Boston.*

"Dec. 16, 1889." — *Framingham.*

"My first case was taken Dec. 16, 1889." — *Boston.*

"Dec. 16, 1889." — *City Hospital, Boston.*

"First case December 17; the prodromal symptoms had existed two or three days." — *Boston.*

"First case seen Dec. 17, 1889." — *Boston.*

"My first case was Dec. 17, 1889." — *Boston.*

"Dec. 17, 1889." — *Pemberton Company, Lawrence.*

"First case seen by me Dec. 17, 1889. Last case Feb. 24, 1890." — *Pittsfield.*

"The first case I saw was on December 17." — *Boston.*

"Dec. 17 to 19, 1889." — *State Almshouse, Tewksbury.*

"First case December 18." — *Boston.*

"About Dec. 18, 1889." — *United States Marine Hospital, Chelsea.*

"About Dec. 18 or 20, 1889. It still (January 28) shows slight activity in this city, new cases appearing daily." — *Lawrence.*

"Dec. 19, 1889." — *State Primary School.*

"Dec. 19, 1889." — *Lyman School for Boys.*

"Dec. 20, 1889." — *Massachusetts General Hospital, Boston.*

"Dec. 20, 1889." — *McLean Insane Asylum, Somerville.*

"Saw my first case Dec. 20, 1889." — *Holyoke.*

"About December 20, but on December 22 a large outbreak of new cases first established to my mind its epidemicity." — *Boston.*

"First appeared in the prison Dec. 21, 1889." — *State Prison, Charlestown.*

"My first case was seen Dec. 21, 1889." — *Bridgewater.*

"My first case occurred Dec. 21, 1889." — *Lowell.*

"First case seen Dec. 22, 1889." — *Rockland.*

"Dec. 22, 1889." — *Children's Hospital, Boston.*

"Dec. 22, 1889." — *Boston Lunatic Hospital.*

"First case Dec. 22; second Dec. 27. Then many cases." — *Westborough Insane Asylum.*

"Dec. 23, 1889." — *New England Hospital, Boston.*

"Dec. 25, 1889." — *State Lunatic Hospital, Northampton.*

"Dec. 25, 1889." — *State Lunatic Hospital, Danvers.*

"About Dec. 25, 1889." — *United States Marine Hospital, Vineyard Haven.*

"About Christmas, — and still prevails slightly (January 24)." — *Dighton.*

"Dec. 26, 1889." — *State Reformatory, Concord.*

"Called to first case Dec. 26, 1889." — *Mittineague.*

"The influenza made its appearance among the people December 27." — *Granite Mills, Fall River.*

"Week ending Dec. 28, 1889." — *Pacific Mills, Lawrence.*

"First case appeared Dec. 28, and it prevailed unceasingly the first three weeks in January." — *Boston Gas Light Co.*

"Last week of December." — *Reformatory Prison for Women, Sherborn.*

"Dec. 30, 1889." — *State Lunatic Hospital, Taunton.*

"Dec. 31, 1889." — *State Farm, Bridgewater.*

"The present epidemic began about January 1, and is still upon us (January 31). Average duration about a week." — *West Tisbury.*

"First case Jan. 2, 1890." — *Nantucket.*

"Jan. 3, 1890." — *State Industrial School.*

"Saw first case Jan. 4, 1890." — *Nantucket.*

"First week in January." — *Asylum for Chronic Insane, Worcester.*

"First case January 11; the following day 24 men were taken ill at noon; the next day 8 more; and, on January 14, 20 more." — *House of Correction, Pittsfield.*

"January 14." — *Orleans.*

QUESTION 2 (both circulars). — *Period of greatest prevalence.*

To this question there were received 350 replies, of which 182 were from physicians, 22 from public institutions, and 146 from employers, which may be classified as follows: —

	Physicians.		Public Institutions.		Employers.		Total.	
	Number of Replies.	Percentage.	Number of Replies.	Percentage	Number of Replies.	Percentage.	Number of Replies.	Percentage.
Week ending December 28, .	21	12	4	18	9	6	34	9
January 4, .	48	26	7	32	27	18	82	23
January 11, .	79	43	6	27	68	47	153	44
January 18, .	27	15	5	23	33	23	65	19
January 25, .	5	3	–	–	9	6	14	4
February 1, .	2	1	–	–	–	–	2	1
	182	100	22	100	146	100	350	100

An examination of this table shows that 43 per cent. of the physicians specify the week ending January 11 as that of the greatest prevalence of the epidemic, and 47 per cent. of employers specify the same date or week. A greater percentage of the replies from physicians specify an earlier date than a later, the ratios being as 38 to 19; while the opposite is true of the replies from employers, the ratios in the latter class of replies being as 24 to 29.

The observations therefore of physicians as to the greatest prevalence of the disease among the population at large show that its prevalence among them was noticed at a slightly earlier date than among the special classes employed in certain occupations.

The period of greatest prevalence, as stated by the different observers from whose reports this article is mainly compiled, agrees quite closely with the statistics of the cities of the State. The influence of the disease upon their death-rate is shown quite clearly in the tables of Massachusetts cities presented at the close of this paper. (See appendix.)

The effect upon the mortality-rate was first perceptible in Boston in the week ending December 21, and reached its climax in the week ending January 11.

In other parts of the United States the progress of the disease was marked in a similar manner, the rise and decline in the mortality rate in New York being nearly contemporaneous with that of Boston, or possibly a little later. About 1,500 deaths may be attributed to its influence in New York city for the two months ending with February 8. In Philadelphia, the increase of deaths was 1,344, the course of the epidemic being about a week later than in New York and Boston. In Cleveland, O., the increase of deaths was 363, and the course of the epidemic a week later, beginning in the first week of January and culminating in the week ending January 18. In Chicago, the mortality rate bore evidence of the effect of the disease a week earlier than in Cleveland. Here it was longer in reaching its crisis than in the eastern cities. One thousand five hundred deaths were attributed to its influence in Chicago, of which number the unusual ratio of 51.6 per cent., or 774, were deaths of children under five years of age. The increase of deaths in Baltimore in the

epidemic was 153; in Washington, 178; in Cincinnati, 155; and here its crisis was two weeks later than in Boston. In St. Louis, the increase amounted to 192 deaths.

In the southern cities of the United States its appearance was later, and its effect upon the death rate less marked than in the northern cities.

The following extracts are taken from the replies, having reference to the date of greatest prevalence of the epidemic: —

"Week ending Dec. 28, 1889." — *United States Marine Hospital, Chelsea.*

"Dec. 23 to 30, 1889." — *Massachusetts General Hospital, Boston.*

"Last of December." — *New England Hospital, Boston.*

"Week ending Dec. 31, 1889." — *Children's Hospital, Boston.*

"Last week of December." — *State Primary School.*

"Dec. 29, 1889, to Jan. 4, 1890." — *Boston Lunatic Hospital.*

"Week ending January 5." — *Massachusetts State Prison, Charlestown.*

"First week of 1890." — *City Hospital, Boston.*

"First week in January, 1890." — *State Almshouse, Tewksbury.*

"First week in January." — *McLean Asylum, Somerville.*

"First week of January." — *Lyman School for Boys.*

"Jan. 2 to 9, 1890." — *State Reformatory, Concord.*

"Week ending January 11." — *Pacific Mills, Lawrence.*

"Week ending January 11." — *Pemberton Company, Lawrence.*

"From January 4 to 11, 43 cases in one week." — *Westborough Asylum.*

"Jan. 1 to 11, 1890." — *United States Marine Hospital, Vineyard Haven.*

"First two weeks in January, more than half of all my cases. Largest number in second week in January." — *Pittsfield.*

"From Dec. 31, 1889, to Jan. 15, 1890." — *State Farm, Bridgewater.*

"The number of victims increased rapidly, and continued to increase until January 13, when a large percentage returned to work; and since that time the number off work has steadily decreased, and to-day (February 4) there are only seven cases among 836 employees." — *Granite Mills, Fall River.*

"Second week in January." — *Asylum for Chronic Insane.*

"Second week in January." — *State Lunatic Hospital, Northampton.*

"My most numerous calls were from 6th to 16th of January." — *Boston.*

"From the 7th to 17th of January." — *Dighton.*

"Week beginning Jan. 12, 1890." — *State Lunatic Hospital, Danvers.*

"Equally prevalent in second and third weeks of January." — *State Lunatic Hospital, Taunton.*

"Third week of January." — *State Industrial School.*

"January 9 to 21." — *Reformatory for Women, Sherborn.*

"January 20 to 27." — *Orleans.*

QUESTION 3 (circular to physicians and public institutions). — *Ratio of the population attacked.*

The replies to this question present a wide range, the variability being from 2 per cent. up to 90 per cent. Out of 166 replies to this inquiry, 98, or 59 per cent., stated the ratio as between 10 and 50 per cent.; 17 observers stated it as 10 per cent. or less; and 41 as above 50 per cent.; 3 only stated the proportion of those attacked as above 80 per cent. of the population.

The general averages of all the replies indicated that 39 per cent. of the population at large were affected by the epidemic to a greater or less degree of severity.

Of the replies from public institutions, 22 of which stated the percentage of those attacked, 14 only stated the number of inmates who were resident in those institutions at the time of the epidemic. Of these persons living mostly within doors, 5,718 in number, 1,665, or 29 per cent., were attacked.

The following extracts are made from the individual replies received from physicians and superintendents of public institutions: —

"One-half of all adults; one-quarter or less of children under ten." — *Georgetown.*

"Affecting fully two-thirds of the population. In some instances the schools were closed, so many pupils were attacked." — *West Tisbury.*

"Ten per cent. Nearly everybody claims to have had *la grippe*, but I prefer to base my statement on the actual observations of physicians and on evidence derived from the pupils in the schools." — *Framingham.*

"Of the families whom I visited 44.7 per cent. had the disease." — *Boston.*

"From two-thirds to three-fourths." — *Boston.*

"About 25 per cent. in the households to which I am habitually called." — *Boston.*

"I should say one-third." — *Boston.*

"Two-thirds. In Back Bay District." — *Boston.*

"Cannot say. For five weeks following December 20 about 55 per cent. of the visits I made were for influenza." — *Boston.*

"About 40 per cent." — *State Prison, Charlestown.*

"Thirty-three and one-third per cent. Population, 6,251. Cases of *la grippe*, 207." — *State Reformatory, Concord.*

"Forty per cent." — *Reformatory for Women, Sherborn.*

"Fifty-six cases out of a total population of 105" (53 per cent.). — *House of Correction, Pittsfield.*

"About two-fifths of the officers and one-third of the inmates." — *State Almshouse, Tewksbury.*

"One hundred and fifty-nine cases in all; 29 in hospital; the remainder mild." — *State Farm, Bridgewater.*

"I find it hard to answer question 3. It seemed at one time that every one resident in the hospital had some symptoms of the disease. Many were sick enough to go to the wards, but kept about their work." — *Massachusetts General Hospital, Boston.*

"Three-fourths of patients in hospital of 60 beds." — *New England Hospital, Boston.*

"About 25 per cent. of patients." — *City Hospital, Boston.*

"About three-fourths of the resident officers and employees and one-third of the patients." — *Children's Hospital, Boston.*

"Fifty-six per cent." — *State Primary School.*

"Population, 117; 49 or 42 per cent. attacked." — *State Industrial School.*

"Sixty-nine per cent." — *Lyman School for Boys.*

"About 50 per cent. of inmates of hospital." — *United States Marine Hospital, Chelsea.*

"About 15 per cent." — *State Lunatic Hospital, Taunton.*

"Ten per cent. Not as prevalent in the hospital as in the city." — *State Lunatic Hospital, Northampton.*

"Thirty per cent." — *State Lunatic Hospital, Danvers.*

"Ten per cent.; 336 inmates, 34 cases of influenza; only 2 of these were patients." — *McLean Asylum.*

"Five per cent." — *Asylum for Chronic Insane, Worcester.*

"Total patients were about 460, — 275 females and 185 males; also about 140 employees and families. Among these there were 150 cases of influenza, 100 females and 50 males." — *Westborough Insane Hospital.*

"Eighteen per cent." — *Boston Lunatic Hospital.*

"Thirty cases out of 65 inmates had it." — *Adams' Nervine Asylum.*

Question 4 (to physicians and public institutions). — *Age-periods of life mostly affected.*

To this question there were returned, from physicians and public institutions, 185 replies. Those from the public institutions should not be reckoned in making a general estimate, since all of them, except the State Almshouse at Tewksbury, contain classes of people of selected ages, not distributed in similar ratios to the general population.

Different expressions are employed in answering this question, in some instances exact periods of life, such as the periods 0–10, 10–20, etc., are employed, and in others the general terms "adults," "children," etc.

For the purposes of this inquiry the latter may be deemed to be sufficiently accurate, and the following classification may be adopted: —

Of the replies specifying children as most affected the number was,	2
Children and young adults,	1
Children and adults,	14
Children and old age,	1
Young adults,	3
Adults,	115
Adults and old age,	17
Old age,	6
All ages,	26

The following extracts from individual returns present points of special interest: —

"Have had 63 cases from December 25 to January 25; 17 were under 10 years old, 7 from 10 to 20, 8 from 20 to 30, 8 from 30 to 40, 23 were over 40. I think, as a rule, those from 12 to 30 suffered more acutely than those who were older, but it took those who were older a longer time to recover from the effects." — *Sandwich.*

"It attacked all ages about alike." — *North Adams.*

"Adults of all ages." — *Pittsfield.*

"It seems to attack families and go through the whole number, generally beginning with the parents." — *Pittsfield.*

"Twenty to fifty years." — *Taunton.*

"Adults more than children." — *Taunton.*

"It affects all ages." — *West Tisbury.*

"Feeble persons and those exposed to out-door air most affected." — *Vineyard Haven.*

"One of the most typical cases occurred in a patient of 80 years, always in doors. He retired well at 8.30; was violently ill at 10.30 with severe occipital headache, lumbar neuralgia, delirium, and with physical signs of catarrhal pneumonia. These all disappeared in four days. Patient now well." — *Georgetown.*

"From 5 to 50 years. Infants and old people appear to escape." — *Westborough.*

"All ages except infants. Children not severely attacked." — *West Newbury.*

"In numbers, the middle aged; in fatality, the aged and debilitated." — *Orange.*

"It is no respecter of persons from 82 down to small children." — *Boston.*

"Comparatively few children attacked." — *Boston.*

"Little difference; youngest, 13 months; oldest, 82 years. Eleven above 60." — *Boston.*

"All ages from infancy to old age." — *Boston.*

"All ages from 6 months to 60 years. Average age of 35 patients was 28 years." — *Boston.*

"The children were exempt." — *Reformatory for Women, Sherborn.*

"All ages." — *State Almshouse, Tewksbury.*

"Young adults, nurses and servants." — *Massachusetts General Hospital.*

"All ages; adults apparently more susceptible than children." — *Children's Hospital.*

"A few cases above 50. Most cases were between 20 and 30. A nearly equal number in each of the periods from 30 to 40 and 40 to 50. About four-fifths as many cases occurred during each of the last two periods as during the period from 20 to 30." — *State Lunatic Hospital, Taunton.*

Question 5 (circular to physicians), Question 6 (circular to employers). — *Which sex was most severely affected?*

To this inquiry there were but 265 replies which could properly be considered with reference to any conclusions to be derived from them, since a considerable number of the public institutions contain persons of one sex only, and the

same is also true of very many of the manufacturing and other establishments from which replies were received.

The replies to this inquiry also lose a part of their actual value by being interpreted variously by different observers, some understanding the inquiry to refer to numbers of persons as compared with the population of each sex, and others interpreting it as referring to the severity of the attack. The former was the meaning intended by the Board.

In many cases, however, the reply is stated with such clearness that no error can be made; and the weight of the answers is so largely in favor of the observation that the male sex was most severely affected, both in numbers and also in the severity of the attack, that we may reasonably conclude that both interpretations are correct.

Of 194 replies from physicians and public institutions, 108, or 56 per cent., state that the male sex was most severely affected; 18 per cent. state the female sex, and 26 per cent. state that the sexes were affected equally.

Of employers, in cases where the sexes were employed in about equal numbers, 42 per cent. stated that the male sex was most severely affected, 18 the female sex, and 40 per cent. stated that the sexes were affected equally.

Dr. Mason reports (Feb. 13, 1890, "Boston Medical and Surgical Journal") that three times as many men were admitted to the City Hospital in Boston with pneumonia as women during the epidemic period.

The following extracts are selected from individual replies: —

"It is principally confined to males." — *West Tisbury.*

"Of 63 cases 28 were males and 35 were females." — *Sandwich.*

"Males most severely, perhaps on account of their greater exposure to weather." — *North Adams.*

"I happened to see more severe cases among women." — *Pittsfield.*

"About equally." — *Taunton.*

"No difference in severity; males suffered in greatest numbers." — *Orange.*

"Males slightly in excess." — *Holyoke.*

"Females, more cases; males, more complications." — *Lowell.*

"Sexes affected about evenly; perhaps slight preponderance of

females in original attack; more complications in males from carelessness in exposure." — *Lowell.*

"No difference in *severity;* more females in *number.*" — *Natick.*

"Men decidedly." — *Rockland.*

"Males; difference not great." — *Westborough.*

"There were 96 males and 9 females in this institution; 56 males were attacked, and no females." — *House of Correction, Pittsfield.*

"About equally." — *State Almshouse, Tewksbury.*

"No difference." — *City Hospital, Boston.*

"Females." — *Massachusetts General Hospital.*

"Male." — *State Primary School.*

"No apparent difference as to sex." — *State Lunatic Hospital, Taunton.*

"Female." — *State Lunatic Hospital, Northampton.*

"Females." — *State Lunatic Hospital, Danvers.*

"Females." — *McLean Asylum.*

"Males." — *Asylum for Chronic Insane, Worcester.*

"More females than males, but worst cases were among men." — *Westborough Insane Asylum.*

"Female." — *Boston Lunatic Hospital.*

"Forty-nine per cent. of females, 29 per cent. of males." — *Pemberton Company, Lawrence.*

"Both sexes were affected alike." — *Appleton Company, Lowell.*

QUESTION 6 (circular to physicians and public institutions). — *Average duration of the attack.*

Replies to this question were received from 207 physicians and public institutions. In a few instances these replies indicate that the writers interpreted the question as meaning the whole period, including acute symptoms and period of convalescence. The intent of the question had reference to the acute stage of uncomplicated cases.

Of the 207 replies, 110, or 53 per cent., stated the average duration of attack as either three, four or five, or from three to five days; 59, or 28 per cent., stated it as from six to eight days; while 17, or 9 per cent., stated it as less than three days, and 21, or 10 per cent., gave a period of more than eight days. Of the latter there were four only who stated a duration of more than ten days.

The following extracts are made from individual replies: —

"About one week, with a week of debility and poor appetite following." — *North Adams.*

"Two or three days of acute attack, followed by two to seven days of weakness." — *Fall River.*

"The fever three days; pain in back and limbs not over twenty-four hours; weakness and mucous cough about two weeks." — *Taunton.*

"Average duration about a week." — *West Tisbury.*

"Five days may be stated as the average duration of the primary attack. The sickness was often continuously prolonged by complications and sequelæ." — *Lynn.*

"Fever generally abated in two days; prostration continuing a week, and sometimes longer." — *Lowell.*

"Longer in adults than in youth." — *Framingham.*

"In children from one to three days; in adults from three days to a week." — *Rockland.*

"Acute stage about three days, with an indefinite period of consecutive prostration. — *Boston.*

"About three or four days." — *State Prison, Charlestown.*

"Three and one-fourth days." — *State Reformatory, Concord.*

"Two to five days." — *Reformatory for Women, Sherborn.*

"Three days." — *Massachusetts General Hospital.*

"Four days." — *New England Hospital, Boston.*

"One week." — *Children's Hospital.*

"Four days." — *State Primary School.*

"About four days." — *State Industrial School.*

"Four or five days." — *United States Marine Hospital, Chelsea.*

"About four days." — *United States Marine Hospital, Vineyard Haven.*

"Five or six days." — *State Lunatic Hospital, Taunton.*

"Forty-eight hours when without complications; those with bronchitis lasted from one to two weeks." — *State Lunatic Hospital, Danvers.*

"Three to four days." — *Boston Lunatic Hospital.*

"One week to ten days." — *Adams' Nervine Asylum.*

QUESTION 7 (to physicians and public institutions). — *Predominant symptoms observed.*

This question was answered in some form by all of the observers except three. Many expressed the predominant symptoms in groups, under the head of nervous, catarrhal, and enteric. General nervous symptoms were specified as predominant by 184 observers, catarrhal by 139, and enteric

by 30. Febrile symptoms were noted by 21 observers, of whom 15 specified the following degrees of temperature as observed: 99 to 103½ F. by two observers, 100 to 104, 101 to 102½, 101 to 103, 101 to 104, 102 to 103, 102 to 104, 102 to 105, 102½, 103, 103 to 105, 103⅖, 103 to 105, 104 to 105, and 105 by one each, 105 being the maximum. Rigors were noted by 4 Under the head of nervous symptoms, neuralgia was specified by 13; depression, exhaustion, debility, weakness and prostration by 25; pain and weakness in the back, head, arms, legs, bones, heart and eyes by 19; soreness by 2, insomnia by 4, mania or delirium by 5, mental and physical depression by 2, convulsions in children by 1; paralysis in old age, aggravated, 1.

Cough, dyspnœa, asthma, coryza and epistaxis were noted by 9.

Nausea and vomiting by 15; loss of appetite, 2; gastritis, 5; diarrhœa, 6.

Tonsilitis, 8; laryngitis, 5; pharyngitis, 5; sore throat, 3.

Hepatitis, 1; hyperactivity of liver, 1.

Conjunctivitis, 3; otitis, 3.

Urinary troubles, 2; low pulse, 1; heart failure, 1; immunity from other diseases, 1.

One observer likens the beginning of the attack to the first or catarrhal stage of measles.

The following replies contain special information upon the points indicated by this question: —

"General malaise, urine diminished and of high color, pains in limbs, soreness all over the body, cough, high temperature." — *Dennis.*

"Seventy-six years old, and not in general practice. Was attacked on October 6, after an hour spent out-of-doors; throat affected, am subject to enlarged tonsils; cough ensued; expectoration very profuse, tracheal and bronchial irritation. Pulse, 90 to 100. Illness lasted three or four weeks, and was then attacked with conjunctivitis of right eye, to which I am subject at times." — *Sandwich.*

"Of 63 cases nearly all had a cough lasting one week or more." — *Sandwich.*

"High fever with slow pulse, severe pains, usually in head or back, tongue white, nausea, vomiting; profound weakness after severe cases." — *Lee.*

"Pain in head and back. Fever. Temperature from 100° to 104° or 105° F. In about half the cases there were lung and bronchial affections." — *North Adams.*

"Symptoms were similar to those of persons attacked with measles, except the eruption." — *North Adams.*

"Fever, seldom above 103°, headache, pain in back and limbs, coryza, cough, debility. In a minority of cases, diarrhœa and abdominal pain or vomiting." — *Pittsfield.*

"Pains in head, back, calves of legs, sometimes abdomen and chest; epistaxis relieving headache; nervous depression present in varying degrees in all cases." — *Pittsfield.*

"Pain in head, back and legs; fever with anorexia; cough in half the cases; coryza, etc." — *Fall River.*

"Fever; temperature, 100° to 102°; rate of pulse, slow; cough; weakness after cessation of primary symptoms." — *Taunton.*

"Chills, fever, pains in back, limbs and head, vomiting, fainting, diarrhœa; in a few, coryza, epistaxis, cough." — *Taunton.*

"The symptoms have been decidedly more variable than in previous epidemics; so much so, that it seems to me that I can recognize three markedly different forms of the disease: *One* beginning suddenly with headache, chilly sensations, sore throat, hoarseness, suffocative cough seemingly confined to the trachea or larynx; wandering pains confined to the thorax; little or no fever; bronchitis.

"The *second* form of the disease begins suddenly, but the principal, and often the only, symptom is fever, temperature averaging 103°. In several cases it exceeded 105°. The fever lasts two or three days, and the temperature then falls to normal, leaving the patient extremely weak for some time. In several instances, after twenty-four or forty-eight hours, the temperature has again risen to 102° or 103°; and it has begun in the morning in nearly every instance, and gradually risen to 102° or 103°, and then fallen again to normal.

"Cases in my own family in which the temperature was taken nearly every hour, presented this peculiarity of returning after twenty-four or forty-eight hours, and beginning to rise in the morning. These cases accompanied with high fever had neither pneumonia, pleurisy, nor inflammation of any organ to explain the fever, the chest being always carefully explored.

"The *third* form is principally neuralgic. Pains of great severity, requiring liberal doses of morphine, occurring in the chest and head, shifting from one part to another, not accompanied with bronchial symptoms or fever, — at any rate, of any note. The principal symptom was *neuralgia*. Have seen but one case where

pneumonia supervened as a complication, and that was in the spring epidemic. I saw four cases of herpes zoster in connection with the epidemic. One old man with valvular disease of the heart died of an attack of influenza.

"*Vomiting* in several cases was a prominent symptom. In two cases it lasted three or four days, patients rejecting all food. One occurred in an infant, one year old, and the other in a boy of ten; they also had cough and fever." — *West Tisbury.*

"In a few cases there seemed to be a tendency to periodical recurrence as in malarial fever." — *Georgetown.*

"In order of frequency: headache, prostration, fever, chills, pain in limbs, coated tongue, cough, vomiting, coryza." — *Gloucester.*

"Chills followed by rapid pulse and high temperature (101° to 105°); headache, often severe; backache, pains in limbs, anorexia; catarrhal affections of the air passages; vomiting, diarrhœa and prostration, depression of spirits and general debility." — *Lynn.*

"Chill, nausea, frequent pulse, high temperature, severe frontal headache, pains in back and limbs. In some cases bloody dejections, epistaxis and bleeding from other mucous surfaces, great prostration and prolonged debility." — *Arlington.*

"There were four well-marked types of the disease in this neighborhood, which gave an impression to many that they were suffering from different diseases: 1, the cephalic, in which intense headache, and in a few delirium, predominated; 2, the catarrhal; 3, the abdominal, — pain in the bowels and sometimes diarrhœa; 4, the rheumatic, — pains in the neck, chest and limbs. In all there was high temperature (105° in one case), very rapid pulse, loss of appetite. I only had three cases that required more than three visits." — *Wellesley.*

"Cases which had least bronchial irritation recovered soonest." — *Rockland.*

"The three symptoms most common were pain in head, back and knees, or the legs just below; in all, fever. All mucous surfaces affected." — *Boston.*

"In order of severity: pain in head, back and legs, prostration, mucous catarrh, cough, vomiting, diarrhœa, insomnia." — *Boston.*

"Severe frontal headache, chilly sensations and sometimes a chill, loss of muscular power, pains in back and lower extremities. About 8 per cent. had diarrhœa, and a small proportion had slight cough and a feeling of intense oppression of chest. Frequent micturition was an occasional prodromal symptom. Sneezing was

not common, but was noticed in a few cases, with abundant nasal discharges. Marked dyspnœa in a few cases. Extreme exhaustion, accompanied with vomiting in some cases, even after all febrile symptoms had disappeared." — *State Prison, Charlestown.*

"Headache, backache, anorexia, prostration out of proportion to other symptoms, pyrexia; catarrhal symptoms not prominent." — *Massachusetts General Hospital.*

"In the maternity, the milk dried up entirely in the four cases attacked. Elevation of temperature was extreme." — *New England Hospital, Boston.*

"Bronchial catarrh, muscular pains, great mental apathy in many cases." — *United States Marine Hospital, Chelsea.*

"Muscular tenderness, pectoral and intercostal, especially with slight chills preceding, followed by the common febrile symptoms. This soreness about the chest muscles was characteristic in my cases." — *United States Marine Hospital, Vineyard Haven.*

"A few committals have been made to the hospital, in which the *mental disturbance* seems to have been dependent upon an attack of the prevailing epidemic as an exciting cause." — *State Lunatic Hospital, Danvers.*

"Headache, slight pyrexia, pain in bones, conjunctivitis." — *Adams Nervine Asylum.*

QUESTION 8 (to physicians and public institutions). — *What other diseases were increased in frequency or severity simultaneously with the epidemic of influenza?*

To this inquiry replies were made by 189 out of the 217 observers to whom the circular was addressed. Out of this number 138 specified pneumonia, 115 bronchitis, 23 rheumatism; phthisis or pleurisy, 9 each; catarrh, 7; heart disease, 5; whooping cough, 5; croup, 3; diphtheria, 3; measles, 2; typhoid fever, 1; erysipelas, 1; bilious fever, 1; nephritis, 1.

In a few instances symptoms appear to have been confounded with distinct diseases. Whether the frequently occurring pneumonia and bronchitis during the epidemic of influenza are to be regarded as sequelæ of the disease, or simply as concomitant diseases due to similar causes, is not within the scope of this inquiry. The facts are presented without attempting to draw inferences or conclusions from them.

The following extracts are made from the individual replies: —

"Out of 63 cases observed in practice, only 3 cases terminated in pneumonia; 2 were under 10 years of age and one over 40; all recovered. One case terminated in intermittent fever."— *Sandwich.*

"Bronchitis a common result. I do not think pneumonia was more prevalent than usual at this season of the year." — *North Adams.*

"Bronchitis especially, which had previously been unusually prevalent. Also rheumatism, neuralgia and whooping-cough. Several deaths from pneumonia supervening upon influenza. Children suffered generally from colds and acute indigestion, without the symptoms of influenza. Such attacks were unusually frequent during the epidemic. If such cases were counted, the proportion of children sick would be as great as of adults." — *Pittsfield.*

"Catarrh; hyperactivity of liver; and, as results of subsequent exposure, pneumonia, bronchitis and neuralgia." — *Taunton.*

"Pneumonia, bronchitis, tonsillitis, pharyngitis, diphtheria, whooping-cough." — *Taunton.*

"Diphtheria was endemic here in the autumn and winter, and, though its force was somewhat spent, it existed in an active degree when the influenza appeared, but it seems to have wholly disappeared immediately after the advent of the latter disease." — *Lawrence.*

"General bronchitis, broncho-pneumonia, lobar pneumonia, pharyngitis, acute inflammatory rheumatism (or an affection resembling it), various neuralgias, hysteria or acute mania, dyspepsia." — *Lynn.*

"Diphtheria to some extent, and pneumonia." — *Easthampton.*

"Pneumonia. Whether this had any direct connection with influenza, or whether it was an independent disease attacking subjects debilitated by influenza, was not clear." — *Arlington.*

"With the first week in January scarlet fever, which had been rapidly increasing for two months, suddenly decreased, so that few cases have since been reported; and the same is true in a less degree of diphtheria." — *Lowell.*

"During the active prevalence of *la grippe* here there was little other illness." — *Rockland.*

"In order of severity: bronchitis, pneumonia, sore throat, heart affections (in persons who had already cardiac mischief), otitis. — *Boston.*

"Tonsillitis and acute bronchitis. Did not have a case of pneumonia at the prison at the time or since, though I met with many cases of it following *la grippe* in private practice." — *State Prison, Charlestown.*

"Phthisis in severity, pneumonia and pleurisy in frequency." — *State Farm, Bridgewater.*

"Apparently lobar pneumonia, but no case of influenza which originated in the hospital resulted thus." — *Massachusetts General Hospital.*

"Discharge from ears, and sore throat, frequent after the attack." — *State Primary School.*

"None in my experience, though cases of bronchitis, pleurisy and pneumonia apply for treatment, but probably not more than is usual at this season." — *United States Marine Hospital, Vineyard Haven.*

QUESTION 3 (circular to employers). — *What ratio of employed persons were attacked?*

Replies to this and the following questions were received from 112 establishments, the number of whose operatives was stated. (The banks are not included in this number.)

The total number of operatives employed in the establishments answering this question was 71,962. The lowest ratio of persons attacked, as stated in any return (except that of one establishment, a cotton mill at West Boylston), was 4½ cent., and the highest was 90 per cent. By far the greater number stated the ratio as from 15 to 50 per cent.

The whole number said to have been attacked was 25,428, or 35.5 per cent.

The following extracts are made from individual replies: —

"Twenty-nine per cent. of in-door employees and 11 per cent. of out-door employees or carriers." — *Boston Post-office.*

"But few sick at any time and did not interfere with our work." — *Springfield Blanket Company, Holyoke.*

"Had no cause for delays or loss of time on account of influenza." — *Germania Mills, Holyoke.*

"Dyeing department, 80 per cent.; spinning department, 25 per cent.; weaving department, 67 per cent.; bleaching department, 87½ per cent.; repair shop (iron), 75 per cent.; repair

shop (wood), 33 per cent.; carding shop (wood), 29 per cent.; dressing shop (wood), 33 per cent.; finishing shop (wood), 75 per cent." — *Boston Duck Company, Bond's Village.*

"Nearly every one; some, of course, very light" (3,200 operatives). — *Merrimack Manufacturing Company, Lowell.*

"It is probable that during the epidemic about 75 per cent. of all our operatives were attacked." — *Appleton Company, Lowell.*

"Nine-fourteenths of all employed persons were attacked." — *Boston Gas Light Company.*

"Singular to relate, this establishment of 300 employees escaped the epidemic. There was but a single case, early in January, absent for one week." — *West Boylston Manufacturing Company, Oakdale.*

"Five hundred and twenty-three persons — 49.2 per cent." — *Bigelow Carpet Company, Clinton.*

QUESTION 4 (circular to employers). — *Ratio of persons employed who were obliged to leave their work for one or more days in consequence of influenza.*

This inquiry was answered by the same number of persons as the preceding. The number of persons whom the epidemic afflicted so severely as to compel them to leave their work for a day or more was somewhat less than the whole number attacked, and in the aggregate amounted to 19,150 out of the 71,037 employed in establishments replying to this question, or 26.9 per cent. of the whole number. The replies to this inquiry, as well as the following, should be regarded as more nearly accurate than any of the others, since the data in most cases were not estimates or conjectures, but were taken from the time-rolls of corporations.

The following extracts are made from individual replies: —

"Forty per cent. I think this estimate is low, if anything, as we counted only those who lost time, thinking perhaps that those who only complained of symptoms did not really have *la grippe*, as nearly all complained of feeling unwell" (500 employed, mostly men). — *Davis & Furber Machine Company, North Andover.*

"Forty-one per cent. actually lost time." — *Pemberton Company, Lawrence.*

"Forty and five-hundredths per cent." (4,336 employed). — *Pacific Mills, Lawrence.*

"Dyeing department, 35 per cent.; spinning department, 25 per cent.; weaving department, 67 per cent.; bleaching department, 75 per cent.; repair shop (iron), 75 per cent.; repair shop (wood), 33 per cent.; carding shop (wood), 29 per cent.; dressing shop, 33 per cent.; finishing shop, 25 per cent." — *Boston Duck Company, Bond's Village.*

"At least 50 per cent." — *Merrimack Manufacturing Company, Lowell.*

"The largest number of absentees was immediately after Christmas, but this is not unusual, and cannot entirely be attributed to influenza, but rather to exhaustion and the strain of Christmas business." — *C. F. Hovey & Co. (Dry Goods).*

"Five hundred and fourteen persons = 48.17 per cent." — *Bigelow Carpet Company, Clinton.*

QUESTION 5 (circular to employers). — *Average length of absence from work (in days).*

Replies were made from 147 establishments to this question, and varied from two days up to thirteen as the longest average absence from work. The average length of time absent from work was 5.06 days.

The aggregate loss of time in days of persons reported in the circulars as obliged to leave their employment for one or more days, amounted to 96,899 days (by 19,150 persons out of 73,773 employed).

"Should think five days a fair average." — *Davis & Furber Machine Company, North Andover.*

"Dyeing department, 6 days, all males; spinning department, 4 days, two-thirds females; weaving department, 6 days, three-fourths females; bleaching department, 5 days, all males; repair shop (iron), 7 days, all males; repair shop (wood), $3\frac{1}{4}$ days, all males; carding shop, 4 days, four-ninths females; dressing shop, 9 days, three-fourths females; finishing shop, 6 days, seven-tenths females." — *Boston Duck Company, Bond's Village.*

Whittenton Manufacturing Company, Taunton, Mass. — Number of Employees afflicted by Influenza — 1889–90.

	Males.		Females.	
	Number.	Hours Lost.	Number.	Hours Lost.
Carding, No. 1,	2	41	6	177
Carding, No. 2, and picking,	21	758	24	634
Spinning, No. 1,	25	1,348	55	3,827
Spinning, No. 2,	20	725	29	1,550
Weaving,	60	2,534	109	6,753
Dressing,	3	74	–	–
Beaming,	17	1,006	–	–
Web drawing,	2	29	20	1,200
Cloth room,	5	285	10	890
Designing,	2	189	–	–
Pattern room,	–	–	4	270
Dye house,	18	1,000	–	–
Machine shop,	9	530	–	–
Wood shop,	8	440	–	–
Engine rooms,	4	205	–	–
Pipers,	1	60	–	–
Yard,	14	835	–	–
Office,	3	70	–	–
Westville mill,	7	330	2	120
	221	10,459	259	15,421

Total employed about 650 males, 550 females = 1,200.

221 males average,	4.73 days.	480 hands,	25,880 hours.
259 females average,	5.95 "	Average,	5.39 days.

Locality.

There are certain questions pertaining to the prevalence of this epidemic in Massachusetts which appear to be affected to a greater or less degree by the location of the observer. These are the dates of the first appearance in different parts of the State, and the period of its greatest prevalence.

On examination of the returns it appears that the epidemic was noticed generally at an earlier date in those counties having a densely settled population living largely in cities than in the counties which are more sparsely settled and in which the population lives largely in small towns. It has been customary, for purposes of interpreta-

tion of registration statistics, to divide these counties into two groups, entitled the urban or manufacturing group and the rural or agricultural group. (See 45th Registration Report, 1886, pp. 101, 102.)

The accompanying table presents the density of population in the two groups of counties, and the density of each county: —

Density of Population in Massachusetts by Groups of Counties.

COUNTIES.	Area in Square Miles.	Persons to Square Mile.	Population, 1885.
Suffolk,	47.6	8,773.0	421,109
Essex,	524.9	502.3	263,727
Middlesex,	858.4	426.4	357,311
Bristol,	587.3	270.0	158,498
Norfolk,	534.6	190.9	102,142
Hampden,	634.8	183.9	116,764
	3,187.6	442.0	1,419,551
Worcester,	1,596.1	152.9	244,039
Plymouth,	698.4	117.0	81,680
Hampshire,	597.4	81.2	48,472
Berkshire,	958.2	77.0	73,828
Barnstable,	516.7	72.0	29,845
Nantucket,	53.3	59.3	3,142
Franklin,	698.2	53.6	37,449
Dukes,	109.9	37.6	4,135
	5,128.2	102.0	522,590
The State,	8,315.8	233.5	1,942,141

The density of the urban group was 442 to the square mile by the census of 1885, and that of the rural group 102. The density of the former group has increased more rapidly than that of the latter in the past five years.

If this division be adopted for the purposes of the present inquiry, and applied to the first two questions contained in the two circulars which were issued, it will be found that there are quite marked differences in the returns from the two groups.

A careful examination of the returns showed that a very large number of the observers stated the first appearance of the epidemic as December 20. The actual number giving

this date was as great as that of any other three days combined. If, therefore, we assume this as the average date of its appearance and divide the time at that day, placing in one group all observers who fix a date at December 20 or earlier and all others in another group who fix a date at December 21 or later, we find the following results, taking the data from all observers, including physicians, superintendents of public institutions and employers : —

Date of First Appearance of Epidemic.

Urban or Manufacturing Group.

COUNTIES.	Observers stating a Date Dec. 20 or earlier.	Observers stating a Date Dec. 21 or later.
Bristol,	8	14
Essex,	17	20
Hampden,	13	9
Middlesex,	32	26
Norfolk,	12	6
Suffolk,	41	9
	123 = 62 %	74 = 38 %

Density of population, 442 per square mile — Census of 1885.

Rural or Agricultural Group of Counties.

COUNTIES.	Observers stating a Date Dec. 20 or earlier.	Observers stating a Date Dec. 21 or later.
Barnstable,	8	8
Berkshire,	13	23
Dukes,	–	5
Franklin,	1	5
Hampshire,	7	16
Nantucket,	2	3
Plymouth,	3	6
Worcester,	11	37
	45 = 30 %	103 = 70 %

Density of population, 102 to square mile — Census of 1885.

By which it would appear that the appearance of the epidemic was generally earlier among the densely settled districts of the State than among those which are sparsely populated.

This observation is emphasized by the fact that the percentages above stated become still more strongly contrasted when those counties presenting the extremes of density in the two groups are considered separately.

In Suffolk County, having a density of 8,773 per square mile in 1885, the ratio of those reporting a date as early as December 20 or earlier, as compared with all observers in the same district, was 82 per cent., instead of 62; while the ratios of those reporting an earlier date in Dukes, Franklin and Nantucket counties, having a density of 52 per square mile in 1885, was only 19 per cent., instead of 30 per cent., of those reporting from the same districts.

By consulting the table on page 340 it will be seen that the week of greatest prevalence, as stated by 153 out of 350 observers, or 44 per cent., was the week ending January 11 (32 per cent. gave an earlier and 24 per cent. a later date). We have therefore adopted the following subdivision as a matter of convenience in comparison: —

PERIOD OF GREATEST PREVALENCE OF THE DISEASE.

Urban or Manufacturing Group.

COUNTIES.	Reports specifying the week ending Jan. 4 or an earlier period.	Reports specifying the week ending Jan. 11 or a later period.
Bristol,	2	17
Essex,	11	28
Hampden,	4	17
Middlesex,	29	36
Norfolk,	11	6
Suffolk,	43	3
	100 = 48 %	107 = 52 %

Rural or Agricultural Group.

COUNTIES.	Reports specifying the week ending Jan. 4 or an earlier period.	Reports specifying the week ending Jan. 11 or a later period.
Barnstable,	2	12
Berkshire,	5	21
Dukes,	1	3
Franklin,	–	6
Hampshire,	3	21
Nantucket,	–	5
Plymouth,	1	8
Worcester,	4	46
	16 = 12%	121 = 88%

The week of greatest prevalence in Suffolk County was reported at the earlier dates by a larger percentage than in the remaining counties of the group, the ratio for Suffolk County being 93 per cent. as compared with 48 per cent. While on the other hand that of Dukes, Franklin and Nantucket counties was but 7 per cent.

Dukes and Nantucket are the island counties of the State, disconnected from the mainland by several miles of salt water (Vineyard Sound), and, at the season of the year in which the epidemic prevailed, intercourse between them and the main land is very limited as compared with that of the warmer season.

Besides these two counties there were but two localities in the State from which returns were received which are not located upon a line of railroad. These were the small adjoining towns in southern Berkshire, from one of which the earliest appearance was noted on January 8, and the greatest prevalence as in the week ending January 25. In the other case the statement is too indefinitely made to be entitled to weight.

In Barnstable County (Cape Cod) which is entirely surrounded by sea coast, and through which one railroad line passes with but little travel in winter, out of sixteen observers five stated dates of first appearance on the follow-

ing dates: two on January 1, one January 2, one January 3 and one January 14.

In Berkshire, out of thirty-six observers eighteen stated date for the first appearance on the following days: eleven on or about January 1, one January 4, two January 6, one January 7, two January 8 and one on January 15.

In Suffolk County, out of forty-three observers one only stated a date later than December 31, and that one was outside the limits of the city of Boston.

Careful examination of the evidence presented in the returns received from all parts of the State appears to indicate that the severity of the epidemic so far as it could be estimated from the ratio of the population who were attacked was not so great upon the island counties and upon Cape Cod as it was in the interior of the State and especially in the cities and large towns. This observation receives greater emphasis when it is considered that the general opinion of the observers is that adults suffered more than children; and the ratio of adults to children is greater in Nantucket, Dukes and Barnstable counties than it is in either of the other counties.

The following observations from the returns have special relation to the effect of locality upon the disease: —

"The disease ran a remarkably mild course in this town." — *Sandwich.*

"I first observed the epidemic of influenza during the spring of 1889, when it appeared in its greatest severity during the months of March and April. I should think that at this time about two-thirds of the inhabitants were affected, though it would be difficult to estimate the number, as many had it who did not call a physician. It seemed to affect all ages alike, but was most frequent among males, especially among fishermen and those who were exposed to inclement weather. The duration was very variable, lasting from a few days to three or four weeks, — average about a week. Saw one case in May, which lasted five weeks. Symptoms in this epidemic were chiefly referable to the respiratory organs, — suffocative cough, fever, headache, malaise." — *West Tisbury.*

"Influenza seems to be a common disease here. I do not think a year ever passes without the appearance of influenza." — *West Tisbury.*

"Larger per cent. in village than in outlying districts." — *Ludlow.*

"I go into four or five adjoining towns. The epidemic began (as regards this locality) in Ayer as a large railroad centre, and reached its height from one to two weeks earlier than in places off the lines of travel, and, as far as my observation goes, affected a larger number of the inhabitants." — *Ayer.*

"Cases in this district comparatively mild." — *Nantucket.*

"The first case was a teacher in one of the schools, who had charge of thirty boys. About December 14 she spent a day in Boston, and was taken ill December 19, recovering in four days. In about five days the boys of her school began to be sick, and 28 had the disease in some degree within two weeks. I should say all were taken within one week, and before the disease appeared in any other school. The disease then invaded the nearest school, and in a few days had reached all of the six which make up the institution. Out of 190 boys, 132 had the influenza. High fever, headache, back and limbs sore and painful, some cough, marked prostration, characterized nine-tenths of all cases." — *Lyman School for Boys.*

"The surgeon of the United States Marine Hospital at Vineyard Haven calls attention to his report to the Supervising Surgeon General, dated Dec. 26, 1889, in which he makes mention of seven cases of influenza treated on December 25, consisting of seamen of the revenue cutter 'Gallatin,' which put in at Vineyard Haven in consequence of this outbreak among the crew. He states: 'This is the first record I have of the appearance of the epidemic here, and shortly after I was seized with an illness of a like character, — slight chills, general malaise, extreme muscular tenderness, particularly about the chest walls. . . . I did not fully recover from the effects of the attack for a week.' He also calls attention to the reports relative to the revenue cutters 'Woodbury' and 'Dallas,' which arrived at Portland, Me., on the 4th and 11th of January with seventeen men sick with influenza, who were taken ill on board while these vessels were cruising at sea." — *United States Marine Hospital, Vineyard Haven.*

The date of first appearance of the epidemic does not appear to have been influenced in a very marked degree by the high or low position of localities in which it appeared. In Berkshire County, which has the highest lands in the State, it appeared at different dates, quite widely separated in point

of time in different towns. Its general appearance in the county, however, was considerably later than in the eastern counties of Suffolk and Middlesex. It was reported at North Adams, Lee and Pittsfield on the 15th of December by four observers, while at Otis Centre, a small town 1,250 feet above the sea, it was not noted till January 8 ; and at Dalton, 1,300 feet above the sea level, on December 29, the latter being situated on the direct line of an important railroad and the former a dozen miles from any railroad. While its appearance at Pittsfield was noted quite early in December by four observers, it did not appear at the county jail in the same town till January 11, when one person was taken ill, followed by twenty-four more the next day and eight more on the second day after.

With reference to the effect of the epidemic upon the population there appears to have been a difference between the sparsely settled sea coast and low, level portions of the State, and the elevated districts in the interior.

The average of the estimates of twenty-three observers as to the ratio of population attacked in the island and sea coast counties of Dukes, Nantucket, Barnstable and Plymouth having a comparatively sparse population was 31.7 per cent., while that of twenty-one observers in the elevated counties of Berkshire and Franklin was 53 per cent.

There were some special exceptions to these observations, as at West Boylston, a village of about 3,000 inhabitants, located in the valley of the Quinepoxet River, in Worcester County, about 400 feet above the sea level, having hills on the north-west and south-west of the town rising to a height of 800 to 900 feet above the sea. The West Boylston Manufacturing Company (cotton goods), located at this place and employing 300 employees, enjoyed a singular immunity, one case only among the operatives being reported, and causing one week's absence from work.

With reference to its prevalence in the public institutions, the average ratio of those attacked in seven lunatic hospitals was but 17 per cent. In five general hospitals it was 55 per cent. In five primary or correctional institutions it was 42 per cent. Its influence was felt more severely by

the attendants and employees than by the inmates or patients.

While the history of influenza and the observations upon its prevalence covering several centuries appear to indicate that its spread is effected through the medium of the air, the data which have herewith been presented also point very strongly to human intercourse as an important but by no means the only factor in its propagation.

The observations made by the reporter from the Lyman School at Westborough, and also by the surgeon of Marine Hospital service at Vineyard Haven, are also worthy of attention as pointing quite strongly in the same direction.

Occupations.

But little can be shown as to any special influence which certain occupations may have had either in limiting or increasing the prevalence or the severity of its effect upon persons employed in such occupations. The principal industries of Massachusetts consist in the manufacture of cotton and woollen goods, machinery, boots and shoes and paper. In these industries the following were noted as the average ratios of persons who were obliged to leave their work for one or more days. The replies to this question may be considered as the most definite index of the effect of the epidemic upon operatives employed.

In 27 cotton mills, 26 per cent.; the extremes being the case already referred to, — the West Boylston mill with less than 1 per cent., — and the highest, 50 per cent., in a mill at Lowell. The average of the operatives attacked in the mills at Fall River was less than half as great as that of the mills at Lowell and Lawrence.

In 13 woollen mills an average of 23 per cent., with a minimum of 8 per cent. and a maximum of 42 per cent.

In 17 boot and shoe factories an average of 33 per cent., with a minimum of 3 per cent. and a maximum of 60 per cent.

In 5 dry-goods establishments in Boston an average of 21 per cent., with a minimum of 5 per cent. and a maximum of 45 per cent.

In 21 banks an average of 24 per cent.

In 10 machine shops, cutlery establishments and similar industries an average of 19 per cent.

In 5 paper mills 14 per cent.

A reply from the Arnold Print Works at North Adams stated that the epidemic "had caused them no serious annoyance." A woollen mill at Holyoke "found no cause for delay or loss of time." A blanket factory, also at Holyoke, was "but slightly affected." From the Boston Gas Light Company the reply was made that "the men who worked at the fires and were subjected to heat and chill, and men of sedentary habits, were attacked. Every man in the retort houses and all of the office men had it, while only one street laborer and none of the yard men were attacked."

At the Boston Post Office: "Of the in-door employees (475 in number) 29 per cent. were attacked; of the carriers (450 in number) 11 per cent. were affected with the disease."

These two latter observations are not in accord with those of a few observers, who stated that the ratio of persons employed at out-door occupations, who were attacked, was greater than that of in-door operatives.

The following statement relative to the epidemic as it affected the operatives in the Pacific Mills at Lawrence, a very large cotton mill, is from the letter of the superintendent, printed in "The Boston Medical and Surgical Journal" of March 13, 1890. The date of the letter was Feb. 20, 1890.

"The epidemic was first noticed in the mills about Dec. 21, 1889, although there were probably a few cases previous to that date, and it continued with more or less severity till Jan. 25, 1890, after which time it gave us no appreciable trouble; but we still have some cases. The height of the epidemic seemed to run from January 4 to January 11. During this week the pay-roll fell off about $5,000 from the regular average.*

"The total loss in wages from December 21 to January 25, as ascertained by comparing those weeks with the average of the pay-roll since January 25, was $11,717. From the reports we have compiled, it will be seen that the epidemic attacked the female

* The total pay-roll is about $30,000 per week.

operatives in large numbers; although, comparing the weaving at the upper mill with any other department of the mills, it would seem to show that the weavers at the upper mill were comparatively free from sickness, while at the lower mill 71 per cent. of the weavers were attacked.*

"The largest percentage of persons kept from work is shown in the pipe shop at the upper mill, where 92 per cent. of the whole number had *la grippe*. The pipers (all men) have no regular place of employment; they are called to all parts of the mill and yard, and are working in very hot rooms and out of doors, perhaps, on the same day. They also have a large amount of night work to attend to; and this may account for the prevalence of *la grippe* among them.

"The question, 'Were the more or less vigorous, the older or younger, employees the more severely affected?' is not easily answered. Reports from the different rooms concerning that question are very conflicting, and are of no value if we leave the weavers out of the question.

"I think I can see some connection between the rooms where we have plenty of fresh air, good light, and comfortable work, and a low percentage of sickness. The spinning-rooms of all the mills were quite severely affected. The work in the spinning-rooms is quite hard, and as exacting as in any other department of the mill; and this labor is performed by young people under the age of twenty.†

"The percentage, however, of sickness in all of the rooms of the yarn mill ‡ is somewhat below that of similar rooms in the other mills, which is a partial confirmation of the theory expressed above.

"The statistics show that 40 per cent. of all the people employed by the Pacific Mills were kept from work; and this means that the work of the different departments has been very seriously hindered during the five weeks which the epidemic covered, and will result in a considerable loss to the mills in various ways.

"After the operatives had returned to work, they were not strong, and many of them had to be favored in order to get any work at all from them; and a large number have gone out from their work a second time."

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* Upper mill, gray cottons; lower mill, dyed cottons and wool; know of no reason for the difference.

† The speed of the machinery makes the spinning-rooms very hot.

‡ The yarn mill is the newest, highest studded and best ventilated mill.

Summary of Statistics of Influenza at the Pacific Mills from Dec. 21, 1889, to Jan. 25, 1890.

DEPARTMENT.	Number of employees.	Number kept from work.	Per cent. kept from work.	Largest number out at one time.	Largest number out during height of epidemic.	Average time out.	Number of deaths.
Upper and yarn mills, .	1,469	399	27.16	215	138	7⅛	–*
Print works, . . .	889	261	29.50	166	114	6	2†
Lower mill, . . .	1,884	1,039	55.15	475	339	6¼	1‡
Total, . . .	4,242	1,699	40.05	856	591	6½	3

* Eight severe cases of pneumonia. † From pneumonia.
‡ From typhoid fever.

The ratio of those who were obliged to leave work in the paper mills being less than that of other industries, it was deemed important to pursue the inquiry further in this direction, and replies were received from eight more paper mills, all in western Massachusetts; the result of which was only to increase the ratio from 14 per cent. to 20 per cent. In one mill it was observed that the epidemic manifested itself more severely among the operatives in the rag-rooms than among those employed in the finishing department.

Inquiries were also made of the large railway corporations in Massachusetts, employing in all about 25,000 persons, which failed to elicit replies of additional value, except that the general impression favored the opinion that the out-door suffered more severely than the in-door operatives.

In this connection it is proper to refer to a single experience recorded by Dr. Laurent of Rouen,* where, in an establishment of public baths where there were employed 18 persons, not one had the least symptom of influenza. He attributed this immunity to the sulphurous vapors attendant upon the baths.

Mortality.

The aggregate loss of life which was occasioned by the epidemic of 1889-90 was large. The ratio of the deaths to

* Revue d'hygiène, February, 1890, p. 150.

the population in Massachusetts was about 12 per 10,000, while the ratio of deaths to the number of those attacked was 31 per 10,000.

This estimate is based upon the returns from the nine largest cities of the State, and upon such other data as could be obtained. In these nine cities the increase in deaths during the two months ending with Feb. 8, 1890, was 1,193, which, upon a population of 900,000, indicates an increase in the death rate of 1.33 per 1,000. Undoubtedly this increase is greater than that of the State at large, since the investigation has shown that the mortality in the cities from this cause was greater than that of the small towns. A further cause for a reduction in this ratio, as applied to the whole State, is to be found in the fact already stated that, in estimating the effect of the epidemic upon the mortality of the entire year, allowance must be made for the hastening effect which the epidemic had upon the mortality from consumption and other wasting diseases; which thus swelled the mortality of the epidemic period, and will undoubtedly be found to result in a corresponding diminution later in the year.

As compared with other epidemics, none within the memory of the present generation have had in so short a time so destructive an effect upon the population of the State. The cholera epidemic of 1849 caused about 1,200 deaths in Massachusetts in about three months; which was about the same ratio as compared with the population of that period. The small-pox epidemic of 1872-73 caused 1,679 deaths; but these were distributed throughout two years. But the recent epidemic of influenza, whose entire period of prevalence in the State was scarcely fifty days (December 20 to February 10) increased the mortality of the State in that time by about 2,500 deaths; which is equal to about 1.2 per 1,000 upon the estimated population.

In further proof of the increased mortality during the epidemic period are the statistics furnished by the life insurance companies. "The British Medical Journal" states that the cost of the influenza to Great Britain was £2,000,000, or $10,000,000, one-half of which was paid by insurance companies and the other half was caused by loss in wages.

In the United States a similar experience was observed. The following table, copied from the transactions of the Actuarial Society of America, presents certain data furnished by twenty-nine life insurance companies, in which the statistics of the first quarter of the year 1890 are compared with the first quarter of the preceding year.

Returns from Twenty-Nine Life Insurance Companies, not including Industrial Business.

Comparison for the First Quarter of the Year.						Ratio to Mean Amount Insured.	
1 Year.	2 Mean Amount Insured.	3 Total Death Losses.	4 Death Losses by Pneumonia and Bronchitis.	5 Death Losses by La Grippe.	6=4+5 Death Losses by Pneumonia, Bronchitis and La Grippe.	Total Death Losses. Ratio 3 to 2.	Death Losses by Pneumonia, Bronchitis and La Grippe. Ratio 6 to 2.
1889, ...	$2,706,129,067	$9,644,781	$1,154,148	–	$1,154,148	.003563	.000426
1890, ...	3,077,107,404	11,845,432	1,827,184	$1,018,460	2,845,644	.003850	.000925
Increase, ...	$370,978,337	$2,200,651	–	–	$1,691,496	8%	117%

"A committee was appointed to obtain fuller statistics and for a period longer than three months, and to report to the next meeting. The data and observations indicate that the epidemic carried away the old policy-holders and many who would readily have succumbed to disease. It is generally believed that the losses by other diseases will be less numerous for the remaining nine months of the year, and make the total mortality for the twelve months about the normal annual average."

In an account of the same society's transactions given in "The New York Times" of April 25, 1890, it is stated that there were in force in the companies represented in the first quarter of 1889, 918,978 policies, and in the first quarter of 1890, 1,028,445 policies. The deaths in the first quarter of 1889 were represented by 3,104 policies, or .338 of 1 per cent., and those in the first quarter of 1890 by 4,048 policies, or .394 of one per cent. The deaths from bronchitis and pneumonia in the first period were 398, and in the second 678, to which must be added those from influenza, 387; making, from these causes combined, 1,065 deaths in the first quarter of 1890.

The force of the epidemic was felt more severely in Massachusetts than in places farther south and in warmer climates, as was shown both by the mortality lists during the epidemic period and by the influence of the epidemic upon those diseases which followed in the train of influenza.

In a recent discussion upon the subject of influenza by the Suffolk District Medical Society, it appeared that the increase in the mortality from pneumonia in Boston during the epidemic was very great, the total deaths from this cause for the two weeks ending Jan. 11, 1890, being 221, or more than 200 per cent. as compared with an average of 49 for the same period in the three previous years.* On the other hand, Dr. Pepper, in an address before the New York Academy of Medicine, April 17, 1890, estimated the increase in mortality from pneumonia in Pennsylvania at 100 per cent.

The mortality from phthisis in the epidemic period was largely increased, the ratio in Boston being nearly doubled as compared with previous years. The mortality from this

* Remarks of Dr. Durgin, "Boston Medical and Surgical Journal," Feb. 13, 1890, p. 154.

cause in Boston for the two weeks ending Jan. 11, 1890, was 116 as compared with an average of 61 for the corresponding period of the three previous years; an increase of nearly 100 per cent.

The increase in deaths from consumption in cities further south was much less marked than it was in Boston. The deaths from consumption for the period of eight weeks ending Feb. 8, 1890, in Washington were 138 as compared with 124 in the corresponding period of the previous winter, and in St. Louis there were 159 in the latter period and 122 in the former.

The following may be taken as a fair sample of the certificates of mortality of a single city, during the epidemic period, which contained direct allusion to the epidemic. Undoubtedly many other deaths were traceable to a similar cause, but were certified as deaths from pneumonia, bronchitis, etc.: —

*Certain Deaths in Cambridge, 1890.**

Sex.	Age.	Died.	CAUSE OF DEATH.
Male, . .	25 years, .	Jan. 5,	La grippe.
Male, . .	35 " .	" 5,	Influenza, congestion of lungs.
Female, .	59 " .	" 7,	Broncho-pneumonia following influenza.
Female, .	55 " .	" 8,	Influenza and debility.
Male, . .	50 " .	" 8,	Heart failure, la grippe.
Female, .	50 " .	" 8,	Influenza and pneumonia.
Male, . .	51 " .	" 8,	La grippe.
Male, . .	58 " .	" 11,	Fatal syncope following la grippe.
Female, .	40 " .	" 13,	Influenza followed by pneumonia.
Male, . .	40 " .	" 16,	La grippe complicated with cerebral meningitis.
Female, .	82 " .	" 19,	Old age and influenza.
Female, .	72 " .	" 25,	Influenza followed by heart failure.
Female, .	57 " .	" 28,	Asthenia following influenza.
Female, .	4 months, .	April 12,	Heart failure, probable sequel to la grippe.
Female, .	21 " .	May 2,	Influenza.
Female, .	27 years, .	" 23,	Anæmia following an attack of influenza.

Conclusions.

1. The first appearance of the influenza in Massachusetts as an epidemic, in the past season, may be stated to have been on the 19th or 20th of December, 1889, and the place of its first appearance was Boston and its immediate neighborhood.

2. It increased rapidly in the number of persons attacked, and reached its crisis generally throughout the State in the week ending Jan. 11, 1890, after which date it gradually declined in severity, and had nearly ceased as an epidemic

* Furnished by Dr. Farnham, Health officer of Cambridge.

by the 10th of February; so that the duration of the epidemic was about seven weeks. It reached its crisis earlier by several days in Boston than in the smaller cities and the remoter parts of the State. Its course was still later in Nantucket, Dukes and Barnstable counties.

3. The ratio of the population attacked was about 40 per cent., — or more exactly, as indicated by the returns, 39 per cent., — or about 850,000 persons of all ages.

4. People of all ages were attacked, but the ratio of adults was greatest; of old people next, and of children and infants least.

5. The weight of testimony appears to favor the statement that persons of the male sex were attacked in greater number and with greater severity than females.

6. The average duration of the attack (acute stage) was from three to five days.

7. The predominant symptoms were mainly of three general groups, — nervous, catarrhal and enteric, the last being much less common than the others; the special symptoms most observed in the nervous group being extreme depression, pain and weakness; in the catarrhal group, cough, dyspnœa and coryza; and in the enteric group, nausea, vomiting and diarrhœa.

8. The chief diseases which followed in the train of influenza, and were intimately associated with it, were bronchitis and pneumonia. Phthisis, when already existing in the victim of the attack, was undoubtedly aggravated; and, in many cases, a fatal termination was hastened.

9. The ratio of persons attacked in industrial and other establishments employing large numbers was about 35.5 per cent., or less than that of the population at large. That of the inmates of public institutions was still less, — 29 per cent.

10. The ratio of persons who were obliged to leave their work on account of illness from influenza was about 27 per cent. of the whole number employed.*

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* If this ratio be applied to the wage-earners of the whole population (this class constituting about one-third of the population, or about 730,000 persons), the number obliged to leave work is found to be 197,100, and the time lost 985,000 days. If to this loss of time, which has an actual money value, there is added the value of the loss in life, the cost of medical attendance, nursing and undertakers' charges, the loss to the State amounts to several million dollars.

11. The average length of their absence from work was five days.

12. Special occupations do not appear to have had a marked effect in modifying the severity of the epidemic upon operatives in such occupations.

13. Various theories have been advanced relative to the method of propagation or spread of influenza. It is not the object of this paper to advocate any theory, but to present all the facts that have been collected from a considerable number of observers. On the one hand certain writers have maintained an exclusive theory of spread by atmospheric agency, and others through the medium of human intercourse alone. We can see no reason, however, for maintaining exclusive theories in regard to the spread of influenza. Other epidemic diseases are undoubtedly communicated by different methods, by different media; and the same disease may be spread by inoculation, by actual contact, by the ingestion or by the inspiration of infectious material. Why, then, should influenza be considered as limited to a single mode of propagation or spread?

If it is spread exclusively by the atmosphere, why should it not follow the direction of the wind? The general direction of the recent epidemic has been from east to west, and in the same general course as the great direction of migration, and also of the migration of that class of people which is liable to carry infection by its conditions and habits of life, conditions of density and overcrowding, and its general neglect of sanitary precautions.

Notwithstanding its rapid spread and its appearance in rapid succession in contiguous countries, it has not travelled faster than the modern modes of locomotion would explain. From the many cases which have hitherto been presented, the observation of the present epidemic in its earlier appearance and more rapid spread in densely settled than in sparsely settled populations, and the numerous instances of its appearance soon after the arrival of people from infected places, the writer cannot avoid the conclusion that, while the atmosphere may constitute one important medium of its communication, human intercourse also suggests itself as an equally important factor.

Appendix.

The accompanying tables and diagrams present the statistics of mortality of certain large cities of Europe during the epidemic period. The total mortality is given, and the mortality from bronchitis and pneumonia. In Berlin and in London the mortality from all respiratory diseases is presented in place of that from bronchitis and pneumonia.

The figures for the weeks having the highest mortality are presented in bold-faced type, and the general progress of the epidemic in time, from north-east to west and south-west, is thus clearly indicated.

Table 2 presents similar data for the principal cities of the United States and for the nine largest cities of Massachusetts. In this table the mortality of the corresponding weeks of the previous winter are also introduced for the purpose of comparison.

TABLE I.

Mortality Rates (Total Deaths and Deaths from Bronchitis and Pneumonia) for European Cities, November, December and January, 1888–90.

[The following table presents the weekly death-rate per 10,000 of population,—not annual].

EUROPEAN CITIES.		Week ending Nov. 9, 1889.	Week ending Nov. 16, 1889.	Week ending Nov. 23, 1889.	Week ending Nov. 30, 1889.	Week ending Dec. 7, 1889.	Week ending Dec. 14, 1889.	Week ending Dec. 21, 1889.	Week ending Dec. 28, 1889.	Week ending Jan. 4, 1890.	Week ending Jan. 11, 1890.	Week ending Jan. 18, 1890.	Week ending Jan. 25, 1890.	Week ending Feb. 1, 1890.
ST. PETERSBURG, Population, 988,016; Lat. 59.56'; Long. 30.18' E.	Total Deaths,	3.98	4.44	6.11	7.62	6.41	4.88	5.89	4.87	–	5.61	5.01	5.79	–
	Deaths from Bronchitis and Pneumonia,	.12	.15	–	.90	.76	.68	.47	.29	–	.20	.27	.23	–
WARSAW, Population, 444,814; Lat. 52.13'; Long. 21.2' E.	Total Deaths,	6.22	5.50	5.87	6.18	6.38	7.57	–	6.65	6.40	5.50	4.67	4.79	–
	Deaths from Bronchitis and Pneumonia,	1.12	1.25	1.03	1.12	1.66	1.79	–	1.86	1.59	1.52	.85	1.00	–
KÖNIGSBERG, Population, 158,489; Lat. 54.42'; Long. 20.30' E.	Total Deaths,	4.79	4.60	4.98	3.97	4.86	5.61	5.23	5.23	8.00	7.63	6.56	5.49	–
	Deaths from Bronchitis and Pneumonia,	.88	.69	.57	.50	.50	1.26	.94	.75	1.89	2.33	1.76	1.14	–
BUDAPESTH, Population, 452,907; Lat. 47.29'; Long. 19.3' E.	Total Deaths,	5.16	4.74	4.74	5.72	5.32	6.97	5.89	6.33	7.08	10.11	9.45	8.52	–
	Deaths from Bronchitis and Pneumonia,	.44	.44	.44	.57	.55	.59	.70	.94	1.08	1.76	2.29	1.85	–
STOCKHOLM, Population, 221,549; Lat. 59.21'; Long. 18.4' E.	Total Deaths,	3.29	4.01	3.70	3.38	3.61	6.27	8.17	3.61	5.41	4.15	4.06	3.56	–
	Deaths from Bronchitis and Pneumonia,	.45	.58	.85	.40	.72	1.62	2.57	.72	1.49	.58	.63	.72	–
VIENNA, Population, 811,434; Lat. 48.13'; Long. 16.23' E.	Total Deaths,	3.77	3.90	4.30	4.46	4.54	6.36	5.72	8.83	8.24	6.70	5.09	5.35	–
	Deaths from Bronchitis and Pneumonia,	.35	.66	.80	.78	.83	.89	1.06	2.21	2.68	1.97	1.15	1.00	–
BERLIN, Population, 1,525,830; Lat. 52.45'; Long. 13.24' E.	Total Deaths,	3.33	3.25	3.36	3.84	3.78	5.03	6.07	7.00	6.01	4.92	4.38	4.39	4.35
	Deaths from Respiratory Diseases,	.17	.91	–	1.25	–	1.59	2.21	2.85	2.46	1.82	1.52	1.85	–

COPENHAGEN, Population, 307,000 Lat. 55.40'; Long. 12.34' E.	Total Deaths,	3.48	3.42	3.51	3.68	3.94	4.30	**5.86**	5.24	5.53	5.50	4.04	4.13	–
	Deaths from Bronchitis and Pneumonia,	.10	.36	.42	.48	.39	.68	.94	**1.49**	.94	.58	.23	.39	–
PARIS, Population, 2,260,945 Lat. 48.50'; Long. 2.20' E.	Total Deaths,	3.97	4.05	4.28	4.51	4.82	5.25	6.00	10.32	**11.86**	9.13	6.60	5.07	4.62
	Deaths from Bronchitis and Pneumonia,	.49	.60	.56	.71	.91	1.07	1.46	3.28	**4.32**	3.34	1.89	1.07	.72
LONDON, Population, 4,421,661 Lat. 50.31'; Long. 0.6' W.	Total Deaths,	3.05	3.28	3.11	3.27	3.80	4.00	4.10	3.82	5.36	**6.21**	6.15	5.03	4.18
	Deaths from Respiratory Diseases,	.72	.72	.65	.68	.97	1.24	1.17	1.05	1.91	**2.41**	2.28	1.66	–
GLASGOW, Population, 528,144 Lat. 55.52'; Long. 4.15' W.	Total Deaths,	4.63	4.39	4.60	4.33	4.84	5.11	5.75	5.60	5.90	**6.25**	5.24	4.92	4.71
	Deaths from Bronchitis and Pneumonia,	1.26	1.42	1.30	1.11	1.57	1.38	1.68	**1.85**	1.81	1.78	1.40	1.06	–
DUBLIN, Population, 353,082 Lat. 53.23'; Long. 6.2' W.	Total Deaths,	4.70	5.04	4.64	5.49	5.32	6.17	6.17	4.70	6.68	8.46	9.20	**9.34**	8.32
	Deaths from Bronchitis and Pneumonia,	.96	.73	.84	.99	1.07	1.38	1.38	1.01	1.90	2.69	3.31	**3.31**	2.40

TABLE II.

Deaths in United States Cities, including Nine Cities of Massachusetts, during the Epidemic Period, December, January and February, 1889–90, and during the Corresponding Season of the Previous Winter.

Cities of United States.		Week ending Dec. 21.	Week ending Dec. 28.	Week ending Jan. 4.	Week ending Jan. 11.	Week ending Jan. 18.	Week ending Jan. 25.	Week ending Feb. 1.	Week ending Feb. 8.	Week ending Feb. 15.
NEW YORK, — Lat. 40.43′; Long. 74.0′ W.	Total deaths, 1888–'89,	779	772	785	739	779	708	783	818	786
	Total deaths, 1889–'90,	665	762	1,202	**1,424**	1,151	872	782	765	742
	Deaths from respiratory diseases, 1888–'89,	160	195	161	151	158	160	150	162	172
	Deaths from respiratory diseases, 1889–'90,	144	206	422	**546**	424	283	208	194	178
BROOKLYN, — Lat. 40.51′; Long. 73.59′ W.	Total deaths, 1888–'89,	341	341	345	344	358	360	333	315	364
	Total deaths, 1889–'90,	333	360	**471**	**624**	586	432	370	365	350
	Deaths from respiratory diseases, 1888–'89,	80	67	93	73	75	63	77	61	72
	Deaths from respiratory diseases, 1889–'90,	51	87	147	**264**	220	132	92	88	95
CHICAGO, — Lat. 41.53′; Long. 87.37′ W.	Total deaths, 1888–'89,	Dec., 1,166		January, 1,255				February, 1,072		
	Total deaths, 1889–'90,	Dec., 1,579		January, 2,501				February, 2,020		
	Deaths from respiratory diseases, 1888–'89,	Dec., 241		January, 271				February, 231		
	Deaths from respiratory diseases, 1889–'90,	Dec., 309		January, 873				February, 508		
ST. LOUIS, — Lat. 38.37′; Long. 19.15′ W.	Total deaths, winter of 1888–'89,	141	156	150	164	162	163	154	165	167
	Total deaths, winter of 1889–'90,	152	127	150	130	174	164	**201**	172	138
	Deaths from respiratory diseases, winter of 1888–'89,	41	38	51	53	52	42	45	56	50
	Deaths from respiratory diseases, winter of 1889–'90,	43	26	42	36	62	61	**84**	66	50
MILWAUKEE, — Lat. 43.4′; Long. 87.57′ W.	Total deaths, winter of 1888–'89,	52	58	66	70	60	64	45	54	75
	Total deaths, winter of 1889–'90,	59	52	61	72	93	91	**120**	91	63
	Deaths from respiratory diseases, winter of 1888–'89,	8	7	12	10	7	10	8	9	10
	Deaths from respiratory diseases, winter of 1889–'90,	15	5	11	17	16	22	**27**	21	8

CLEVELAND, — Lat. 41.30′; Long. 81.42′ W.	Total deaths, winter of 1888–'89,	59	70	73	54	78	74	83	77	–
	Total deaths, winter of 1889–'90,	92	70	101	135	149	144	144	110	–
	Deaths from respiratory diseases, winter of 1888–'89,	12	16	20	11	15	16	24	19	–
	Deaths from respiratory diseases, winter of 1889–'80,	26	14	34	45	59	54	61	47	–
PROVIDENCE, — Lat. 41.49′; Long. 71.25′ W.	Total deaths, winter of 1888–'89,	63	50	52	42	43	57	45	48	60
	Total deaths, winter of 1889–'90,	35	48	72	101	106	69	69	65	58
	Deaths from respiratory diseases, winter of 1888–'89,	12	15	17	12	16	22	16	12	18
	Deaths from respiratory diseases, winter of 1889–'90,	11	17	30	46	58	31	20	17	18
CHARLESTON, — Lat. 32.46′; Long. 79.57′ W.	Total deaths, winter of 1888–'89,	39	33	25	27	29	29	33	37	31
	Total deaths, winter of 1889–'90,	27	29	39	37	24	41	22	31	35
	Deaths from respiratory diseases, winter of 1888–'89,	2	5	2	2	5	3	6	6	5
	Deaths from respiratory diseases, winter of 1889–'90,	3	4	3	4	2	7	4	4	7
SAN FRANCISCO, — Lat. 37.48′; Long. 122.24′ W.	Total deaths, winter of 1888–'89,	107	117	108	115	116	125	117	127	110
	Total deaths, winter of 1889–'90,	98	129	94	124	199	201	214	172	132
	Deaths from respiratory diseases, winter of 1888–'89,	25	21	36	44	45	32	39	38	40
	Deaths from respiratory diseases, winter of 1889–'90,	33	46	25	38	80	83	112	83	48
DETROIT, — Lat. 42.20′; Long. 82.58′ W.	Total deaths, winter of 1888–'89,	75	61	59	63	57	60	69	67	63
	Total deaths, winter of 1889–'90,	65	62	72	100	123	92	55	54	65
	Deaths from respiratory diseases, winter of 1888–'89,	–	–	–	–	–	–	–	–	–
	Deaths from respiratory diseases, winter of 1889–'90,	–	–	–	–	–	–	–	–	–
		37		74				50		
WASHINGTON, D. C., — Lat. 38.54′; Long. 77.34′ W.	Total deaths, winter of 1888–'89,	96	91	104	95	91	111	84	80	–
	Total deaths, winter of 1889–'90,	106	81	95	132	150	161	114	96	–
	Deaths from respiratory diseases, winter of 1888–'89,	18	20	20	17	18	14	18	11	–
	Deaths from respiratory diseases, winter of 1889–'90,	19	16	21	40	61	59	41	24	–
MINNEAPOLIS, — Lat. 44.58′; Long. 93.18′ W.	Total deaths, winter of 1888–'89,	34	43	37	40	50	38	43	29	46
	Total deaths, winter of 1889–'90,	38	39	43	57	74	68	59	49	42
	Deaths from respiratory diseases, 1888–'89,	6	10	5	7	12	6	8	7	12*
	Deaths from respiratory diseases, 1889–'90,	6	3	10	13	25	15	14	8	5†

* Mostly bronchitis.

† Mostly pneumonia.

Table II. — Concluded.

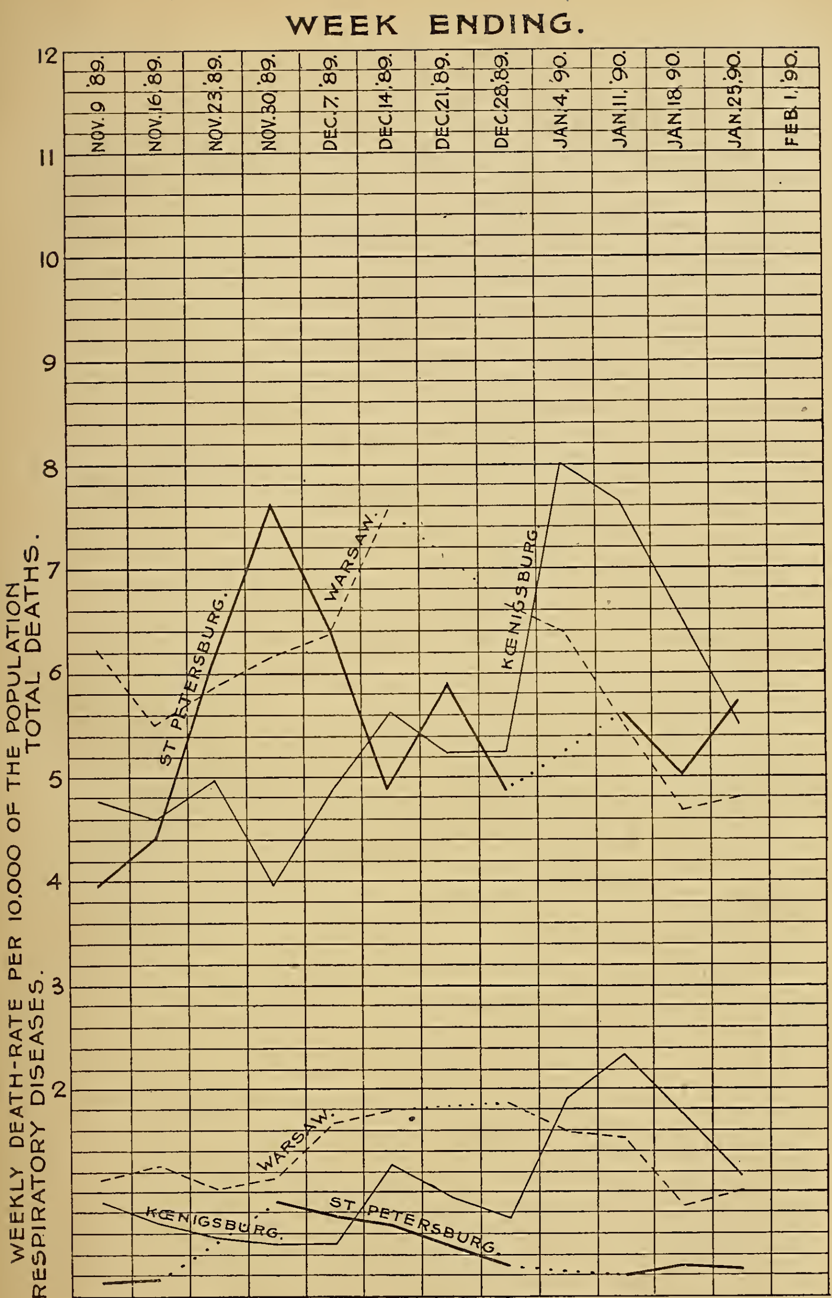
Massachusetts Cities.

CITIES OF UNITED STATES.		Week ending Dec. 21.	Week ending Dec. 28.	Week ending Jan. 4.	Week ending Jan. 11.	Week ending Jan. 18.	Week ending Jan. 25.	Week ending Feb. 1.	Week ending Feb. 8.	Week ending Feb. 15.
Boston, — Lat. 42.21′; Long. 71.3′ W.	Total deaths, winter of 1888-'89,	161	192	177	180	185	198	188	182	185
	Total deaths, winter of 1889-'90,	193	232	348	**416**	345	214	192	169	192
	Deaths from respiratory diseases, winter of 1888-'89,	50	75	61	52	56	64	65	53	61
	Deaths from respiratory diseases, winter of 1889-'90,	56	88	168	**221**	197	94	61	56	54
Worcester, — Lat. 42.17′; Long. 71.48′ W.	Total deaths, winter of 1888-'89,	33	16	28	39	35	25	24	35	26
	Total deaths, winter of 1889-'90,	24	30	23	31	**49**	28	40	23	30
	Deaths from respiratory diseases, 1888-'89,	11	4	16	16	11	9	12	15	15
	Deaths from respiratory diseases, 1889-'90,	11	11	16	12	**26**	14	13	**7**	17
Lowell, — Lat. 42.39′; Long. 71.19′ W.	Total deaths, winter of 1888-'89,	46	33	24	37	37	26	35	31	38
	Total deaths, winter of 1889-'90,	32	46	39	42	**68**	58	55	26	40
	Deaths from respiratory diseases, 1888-'89,	8	4	2	3	6	4	8	6	10
	Deaths from respiratory diseases, 1889-'90,	6	11	9	10	**28**	16	9	2	6
Cambridge, — Lat. 42.22′; Long. 71.8′ W.	Total deaths, winter of 1888-'89,	23	22	24	15	19	19	19	20	–
	Total deaths, winter of 1889-'90,	26	30	30	**48**	31	26	20	27	–
	Deaths from respiratory diseases, 1888-'89,	4	6	5	8	2	3	2	1	–
	Deaths from respiratory diseases, 1889-'90,	5	4	4	**20**	6	5	5	4	–
Fall River, — Lat. 41.43′; Long. 71.9′ W.	Total deaths, winter of 1888-'89,	24	25	32	27	25	30	25	32	–
	Total deaths, winter of 1889-'90,	18	32	19	38	44	**51**	26	37	–
	Deaths from respiratory diseases, 1888-'89,	5	2	6	3	4	4	3	3	–
	Deaths from respiratory diseases, 1888-'90,	3	5	3	5	13	**18**	6	**6**	–
Lynn, — Lat. 42.28′; Long. 70.57′ W.	Total deaths, winter of 1888-'89,	14	22	22	17	17	15	14	23	–
	Total deaths, winter of 1889-'90,	12	15	20	**33**	29	29	15	28	–
	Deaths from respiratory diseases, 1888-'89,	2	7	6	4	3	4	1	5	–
	Deaths from respiratory diseases, 1888-'90,	6	4	14	14	**19**	13	8	11	–

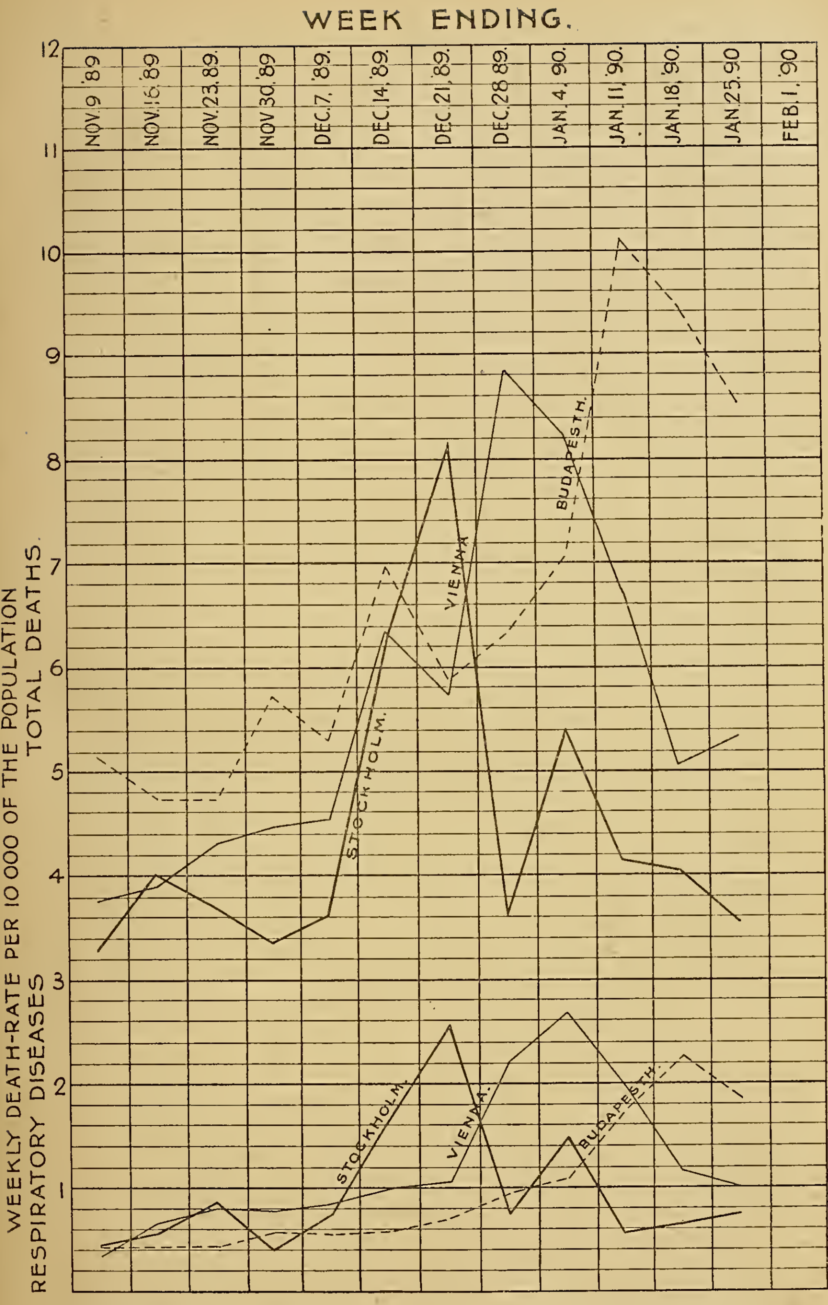
LAWRENCE,— Lat. 42.43 ; Long. 71.10′ W.	Total deaths, winter of 1888-'89,	17	21	14	14	18	14	25	24	-
	Total deaths, winter of 1889-'99,	23	23	23	36	33	47	34	22	-
	Deaths from respiratory diseases, 1888-'89,	3	4	2	4	2	3	4	2	-
	Deaths from respiratory diseases, 1889-'90,	1	3	6	14	11	14	9	5	-
SPRINGFIELD,— Lat. 42.6′; Long. 72.36′ W.	Total deaths, winter of 1888-'80,	9	20	15	16	19	14	15	13	15
	Total deaths, winter of 1889-'90,	10	17	28	26	34	34	26	15	15
	Deaths from respiratory diseases, 1888-'89,	1	7	5	7	3	2	4	3	6
	Deaths from respiratory diseases, 1889-'90,	2	5	9	13	20	20	13	6	7
NEW BEDFORD,— Lat. 41.38′; Long. 70.56′ W.	Total deaths, winter of 1888-'89,	10	8	11	7	10	13	13	8	-
	Total deaths, winter of 1889-'90,	9	18	16	20	24	20	21	16	-
	Deaths from respiratory diseases, 1888-'89,	-	2	2	-	1	1	1	-	-
	Deaths from respiratory diseases, 1889-'90,	-	3	3	5	5	4	4	5	-

Summary of Preceding Table with Mortality Rates.

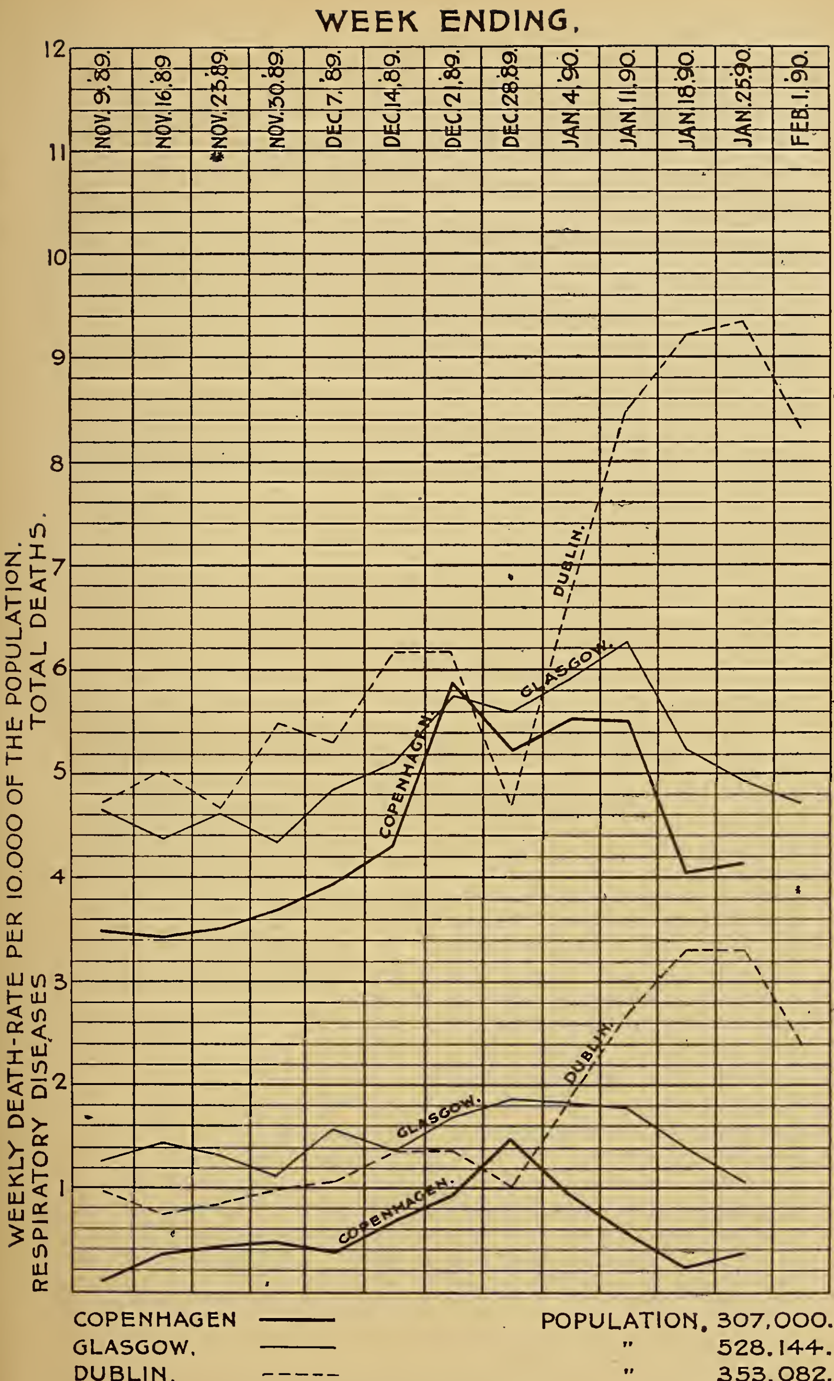
Nineteen cities of United States. Population about 6,000,000.	Total deaths, winter of 1888-'89,	2,048	2,090	2,092	2,042	2,131	2,083	2,078	2,118	-
	Total deaths, winter of 1889-'90,	1,952	2,140	2,874	3,526	3,363	2,750	2,524	2,269	-
	Deaths from respiratory diseases, 1888-'89,	448	505	522	477	491	462	491	469	-
	Deaths from respiratory diseases, 1889-'90,	441	558	977	1,363	1,322	945	791	654	-
Ratios per 10,000 of the living population,	Total deaths, winter of 1888-'89,	3.41	3.48	3.48	3.40	3.55	3.47	3.46	3.53	-
	Total deaths, winter of 1889-'90,	3.25	3.57	4.79	5.88	5.61	4.58	4.21	3.78	-
	Deaths from respiratory diseases, winter of 1888-'89,	.75	.84	.87	.79	.82	.77	.82	.78	-
	Deaths from respiratory diseases, winter of 1889-'90,	.73	.93	1.63	2.27	2.20	1.57	1.32	1.09	-



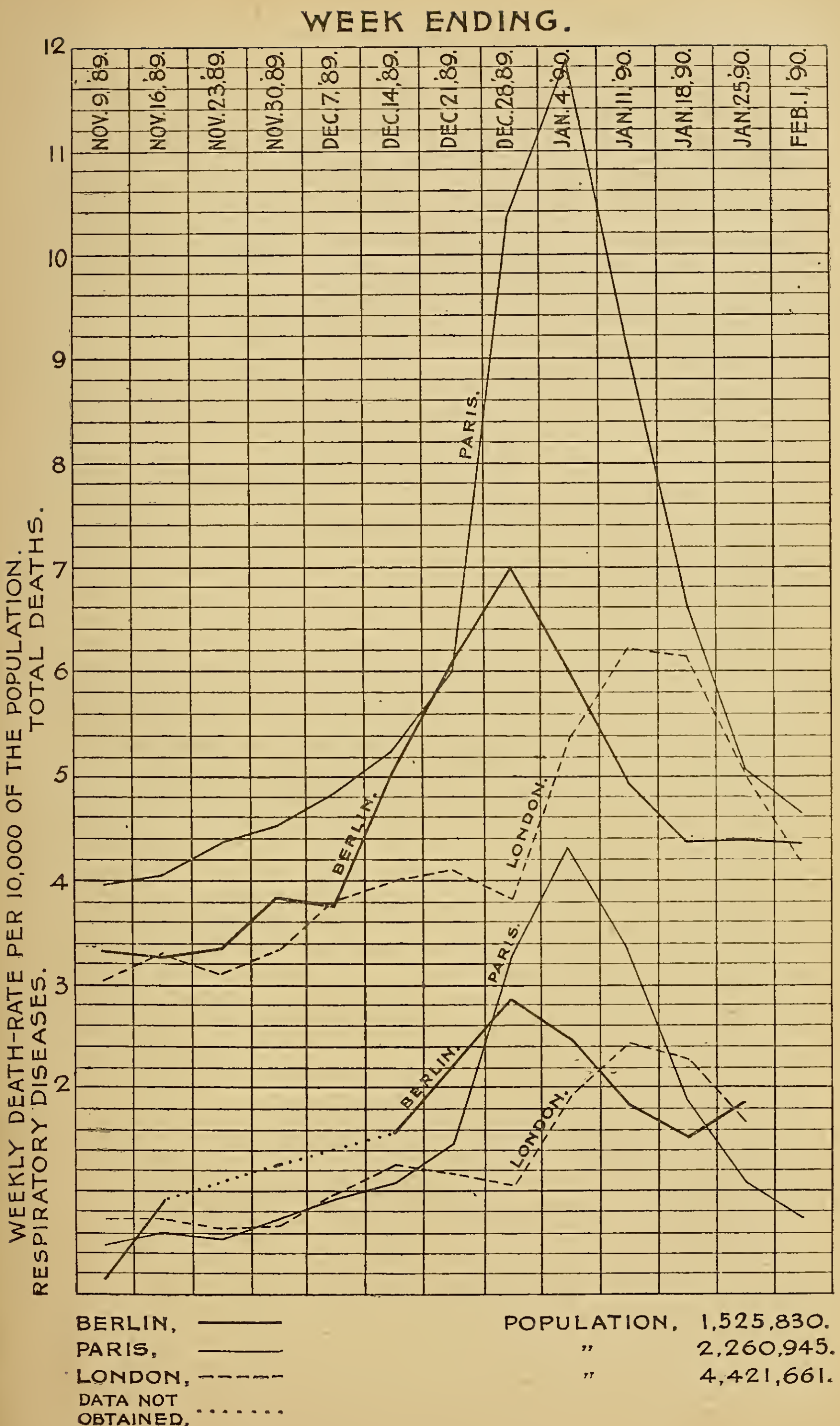
ST PETERSBURG,	———	POPULATION,	988.016.
KŒNIGSBURG,	———	"	158,489.
WARSAW,	– – – – –	"	444,814.
DATA NOT OBTAINED,	· · · · · · ·		

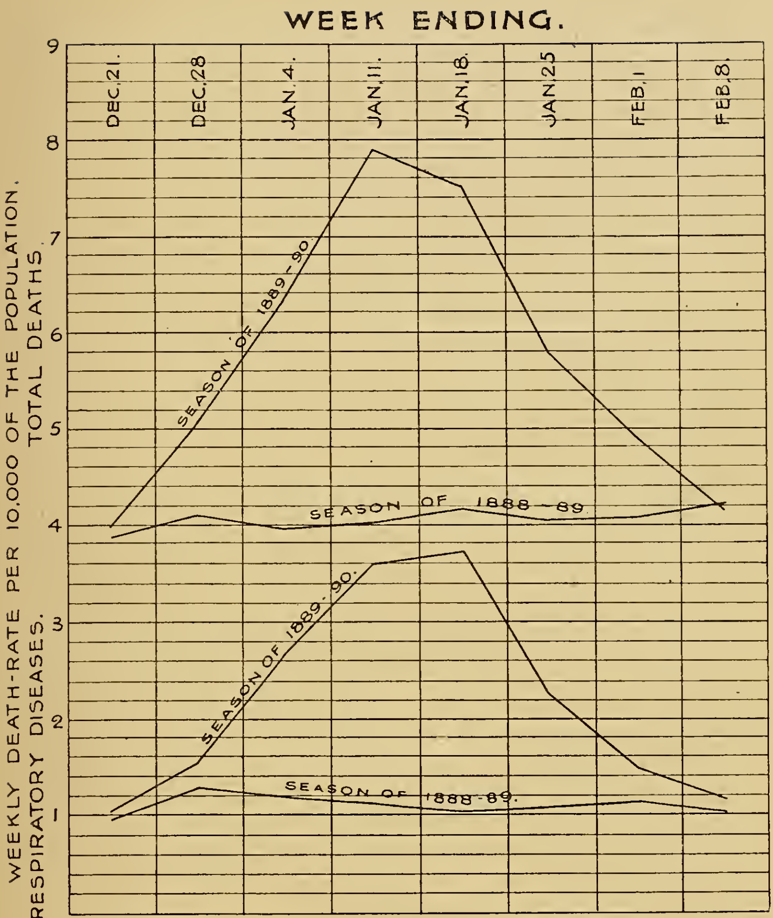


STOCKHOLM. ——— POPULATION, 221,549
VIENNA ——— " 811 434
BUDAPESTH. - - - - - " 452,907



WEEK ENDING.
NOV. 9. 89.
NOV. 16. 89.
*NOV. 23. 89.
NOV. 30. 89.
DEC. 7. 89.
DEC. 14. 89.
DEC. 21. 89.
DEC. 28. 89.
JAN. 4. 90.
JAN. 11. 90.
JAN. 18. 90.
JAN. 25. 90.
FEB. 1. 90.
12
11
10
9
8
7
6
5
4
3
2
1
WEEKLY DEATH-RATE PER 10.000 OF THE POPULATION.
TOTAL DEATHS.
RESPIRATORY DISEASES
DUBLIN.
GLASGOW.
COPENHAGEN.
DUBLIN.
GLASGOW.
COPENHAGEN.
COPENHAGEN
GLASGOW.
DUBLIN.
POPULATION, 307,000.
" 528,144.
" 353,082.


WEEK ENDING.
NOV. 9. '89.
NOV. 16. '89.
NOV. 23. '89.
NOV. 30. '89.
DEC. 7. '89.
DEC. 14. '89.
DEC. 21. '89.
DEC. 28. '89.
JAN. 4. '90.
JAN. 11. '90.
JAN. 18. '90.
JAN. 25. '90.
FEB. 1. '90.
12
11
10
9
8
7
6
5
4
3
2
WEEKLY DEATH-RATE PER 10,000 OF THE POPULATION.
TOTAL DEATHS.
RESPIRATORY DISEASES.
PARIS.
BERLIN.
LONDON.
PARIS.
BERLIN.
LONDON.
BERLIN, POPULATION, 1,525,830.
PARIS, " 2,260,945.
LONDON, " 4,421,661.
DATA NOT OBTAINED,



— NINE MASSACHUSETTS CITIES.—
ESTIMATED POPULATION 875.000

MORTALITY RATES DURING EPIDEMIC OF 1889-90 AND THE PREVIOUS CORRESPONDING SEASON

HEALTH OF TOWNS.


MAP OF THE CITY OF LAWRENCE, WITH THE CASES OF DIPHTHERIA IN 1889.
CASES RECOVERED, THUS: o
DIED, " •
Whole number of cases, 529, deaths, 168.
METHUEN
ANDOVER
NORTH ANDOVER
WARD I
WARD II
WARD III
WARD IV
WARD V
WARD VI
MERRIMACK RIVER
SPICKET RIVER
SHAWSHEEN RIVER
CLOVER HILL
PROSPECT HILL
TOWER HILL
STEVENS POND
RESERVOIR CAPACITY 35000000 GALLONS
LAWRENCE DRIVING PARK
BOSTON AND MAINE RAILROAD
BOSTON AND LAWRENCE - LOWELL AND LAWRENCE RAILROAD
OLD BOSTON AND CONCORD TURNPIKE
LOWELL ROAD
TO LOWELL
Pacific Mills
Washington Mills
Everett Mills
1 Mile
1½ Miles

LAWRENCE.

An Inquiry relative to the Conditions which attended an Unusually High Rate of Mortality in Lawrence in 1889, with Special Reference to Diphtheria.

During the year 1889, and especially in the last half of the year, the number of deaths in Lawrence increased considerably when considered in connection with the estimated population of the city; and the increase over the mortality of the previous years was so marked that it was deemed advisable to make an inquiry with reference to the same, and to ascertain as far as possible what were the conditions and causes which prevailed during the year which might account for an unusual death-rate. In the pursuit of such an inquiry the Board follows the recommendation made by the sanitary commission of 1850, in their report to the Legislature, — a report which has served as a model of excellence in the direction of sanitary inquiry during the years which have succeeded its publication.

In that report it was recommended "that special sanitary surveys of particular cities, towns and localities should be made from time to time under the direction of the general board of health." In the same report the city of Lawrence was selected as a model for such work, and we have therefore herein presented certain data which are available for comparison after the lapse of forty years.

Previous to 1845 the site now occupied by the city of Lawrence was a sparsely settled farming district lying upon both sides of the Merrimack River between the towns of Methuen on the north and Andover on the south. From the date of its first settlement in 1845, the following figures show its increase of population: United States census of

1850, 8,282; of 1860, 17,639; of 1870, 28,921; of 1880, 39,151; of 1890, 44,505. It is the population incident to a manufacturing city and is made up of people of different nationalities, of which, beside native Americans, there is a large ratio of Irish and French.

The Merrimack River flows through the city from east to west, and receives as its tributaries the Shawsheen on the south and the Spicket on the north side. The flow of the Merrimack River is obstructed by a dam where the canals are diverted, one on the north and one on the south side of the river, to supply water power for the series of large manufacturing establishments. The portion of the city upon the north side contains the majority of the population. The top of the dam is thirty-five feet above high tide. Two hills, one on the east and the other on the west border of the city, rise to a height of one hundred and forty feet above the dam.

The soil is generally dry and sandy in the densely inhabited northern portion, with clay gravel along the northern border. That portion of the city which lies south of the river is more level than the northern portion.

The streets are regularly laid out, being from fifty to eighty feet in width and generally two hundred feet apart in the older portion of the city. They were so planned as to admit of surface drainage and also of a sewerage system. One large sewer five feet in diameter passes under the canal near the foot of Lawrence Street and into the river.

In the early history of the city considerable attention appears to have been paid to its sanitary condition, and public measures were adopted for the preservation of the public health. Restrictions were imposed by the Essex Company upon the use of the lands which were sold upon certain streets. The domestic water supply was obtained for several years from wells. It was then considered as a good drinking water "but hard for many purposes."

The public water supply of the city was introduced in 1876. It is obtained from the Merrimack River, upon the northern bank, at a point about one mile above the dam, where it is pumped to a reservoir upon a hill on the western border of the city.

The following is the analysis of this water as stated in the forthcoming supplementary report of the board upon water supply and sewerage : —

Chemical Examination of Water from a Faucet at the Experimental Station of the State Board of Health at Lawrence.

	Appearance.	Residue on Evaporation.			Ammonia.			Nitrogen as	
	Color.	Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid.	Chlorine.	Nitrates.	Nitrites.
Average of 81 samples, .	0.23	3.83	1.14	2.69	.0014	.0107	.21	.0197	–

Note. — The average above given was obtained by taking the mean of all the analyses for the month and averaging these results.

The mill-pond produced by the dam at Lawrence flows back to the foot of Hunt's Falls in Lowell, nine miles distant. In consequence of the great length of the overfall, the height of water in the pond varies much less than in other parts of the river and not sufficiently to overflow the banks and affect the health of the inhabitants.

The principal mill corporations occupy the space on the northern bank of the river for about one mile below the dam. There were employed in these mills in 1880 over twelve thousand operatives and the weekly product was over twenty-eight million yards of cloth.

The character of the dwellings in the city differs much, as in most manufacturing cities, many very comfortable and substantial residences being located upon the hills and other lands in the suburbs and also upon the streets in the immediate neighborhood of the common. On the other hand there are some parts of the city where many houses exist in close proximity to each other, mostly wooden structures of a cheap sort usually having from four to six tenements in each. Large wooden blocks intended for a large number of families are not common. The brick blocks erected by the corporations are of an intermediate class but much better in their adaptation to the wants of their tenants than the average of such structures which were built at the same period. Those who planned them paid considerable regard to the sanitary wants of the population who were to be the future tenants.

The following description of a portion of these buildings is copied from the report of the sanitary commission of 1850 already quoted : —

The boarding-houses consist of blocks substantially built of brick and covered with slate; each 250 feet in length, 36 feet in breadth, three stories high, of 10, 9 and 8 feet respectively, with 4 Ls in the rear, one story high, to each block. Each block contains 8 tenements, and each tenement, except the end one, is $33\frac{1}{3}$ feet in width, and 36 feet in depth exclusive of the L, and contains 20 rooms including the attic; and is designed for 36 boarders. The end houses are 25 feet in width, a little smaller than the others. One small room at the side of the front hall is appropriated exclusively to the mistress of the house. On the other side of the hall are two dining-rooms connected by folding doors, each forming pleasant sitting-rooms at other than meal times. Passing through the hall you enter the kitchen, which is furnished with all necessary conveniences. Beyond this is the back kitchen, containing a large boiler and conveniences for various other household purposes. In the rear of this is the wash room, from which you pass into a large yard enclosed by a high, tight fence, having at the end the woodshed, 14 feet wide, and the privies; the whole bordering on a common passageway 14 feet wide. Under each alternate fence is a double cesspool, serving for two houses and having an underground passage leading to the common sewer under the sheds. A well of pure water is connected with every four tenements, and all are supplied with soft water for washing and other purposes by cast-iron pipes leading from cisterns in the mills to the sinks in the several houses. [Since the foregoing was written, city water has been supplied to all of these houses.] On the second floor is the parlor, and also a sick room, — a small chamber with a fire-place, designed for an invalid who may need seclusion and extra warmth. Besides these are sleeping apartments for the boarders in the second and third stories and in the attic, designed to accommodate 2, 4 or 6 persons in each, according to the size of the room. Each tenement cost about four thousand dollars exclusive of the land, and will compare to advantage with respectable dwelling-houses in Boston and are much better than the average in country villages.

To protect the health of the inmates underground sewers are constructed, under the sheds in the rear of each block, through which a current of water, supplied by iron pipes connected with the canal, is constantly running, — carrying off all the contents of the privies, cesspools and other filth, and, passing at right angles

under the canal, discharging them into the river and preserving the houses perfectly free from offensive smells.

A careful code of regulations was adopted for the government of these corporation houses, from which the following rules having special sanitary significance are quoted : —

VII. It is indispensable that all who live in the houses should be vaccinated ; and this will be done at the expense of the company, by a physician at the counting room, for all those employed by the company and for the families of its tenants.

VIII. The health of the inhabitants requires that particular attention should be paid to the cleanliness and daily ventilation of the rooms.

IX. Neither water nor filth of any kind must be thrown in front of the houses, nor be allowed to remain in the cellars, back yards or sheds.

. . . .

XII. A suitable chamber for the sick must be reserved in each house, so that they may not be annoyed by others occupying the same room.

XIII. Window glass must not be allowed to remain broken more than one day.

XIV. Wood and coal must not be taken into the cellars, nor from them, through the front windows.

XV. The closest supervision will be exercised to enforce these rules, and the tenants themselves are particularly required to pay close attention to them and to insist upon their observance on the part of their boarders.

XVI. No tenement will be leased to persons of immoral or intemperate habits, and any tenant who after occupancy shall be found to be of such habits, or to receive boarders of such habits, will be notified to vacate the premises.

It is further stated with reference to this code of regulations : "The influence of the system by which the boarding-houses are regulated is immensely beneficial, whether we consider it in a social, moral or sanitary point of view. It is an influence which is felt by all the operatives at all times, while they are out of the mills as well as in them."

During the earlier years of the history of Lawrence, and before it had accepted a city charter, the selectmen constituted the board of health and issued a code of sanitary regu-

lations for the town. Five of these regulations had reference to the construction, maintenance and care of privy vaults, and one of them may perhaps account to some extent for the unusual proportion of these structures still in existence in the city.

It appears that the death-rate of Lawrence for 1849, the year previous to the report of the sanitary commission, had been unusually high (at least 20 per 1,000 of the living population), and had been commented upon by that commission as follows, so far as the probable causes were concerned: —

1. The transitory habits of the population.
2. The bringing together of persons and adventurers of different characters and habits, sometimes with broken fortunes or debilitated constitutions.
3. The digging up and removal of soil and earth, producing unwholesome exhalations.
4. Exposure in working in mud and water, building dam, etc.
5. Insufficiency of house accommodation.
6. Habitations; habits and modes of living of laborers: all these causes resulting in fevers, dysentery, consumption and other fatal diseases.

It was recommended that rules be made to prevent nuisances and overcrowding, to introduce a pure water supply, the drainage of wet lands, regulate burials, prevent intemperance and crime, to make inspections relative to occurrence of sickness, and to require a report yearly from the board of health.

During the years immediately preceding the report of 1850 the mortality record of the town, which was apparently somewhat imperfect, presented the following data: —

An enumeration of the inhabitants made in February, 1847, gave a population of 3,577; another in January, 1848, gave 5,949; another in September, 1849, gave 7,225; and the United States census of 1850 (June) gave 8,500. The certified deaths of 1847, May to December, were 84; those of 1848 were 83; and of 1849, 162. Omitting the fractional period of 1847 the death-rate of Lawrence in 1848 was 13.9 per 1,000, and in 1849, 22.4 per 1,000. Whether

this great difference in estimated mortality rates was due to imperfect registration in the former year, or to other causes, cannot at this day be ascertained.

Of the deaths registered in the years 1847, 1848 and 1849, there were from the principal infectious diseases: dysentery 26, typhus (typhoid) 52, cholera infantum 4, croup 4, measles 11, scarlet-fever 18, and from consumption 58. Let us now compare these figures with those of later years and especially with those of 1889, considering first the general mortality rate, and secondly the mortality from the principal infectious diseases.

General Mortality Rate.— The following table presents the mortality statistics of the city for the forty-two years ending with 1889, which includes nearly the entire period of the existence of the city as a corporate municipality. In this table are presented the following data: First, the population for each year. The census of the first two years was made from actual count of the population, made in January, 1848, and in September, 1849. The growth of Lawrence from its establishment as a town in 1845, for the succeeding ten years, was very rapid. The populations of 1850, 1860, 1870 and 1880 are the enumerations of the United States census; and those of 1855, 1865, 1875 and 1885 are the figures of the State census. For the intervening years the populations are estimated, the increase or decrease between two successive census years being equally distributed.

The growth of Lawrence has presented certain remarkable variations. Between 1850 and 1855 the increase was 94 per cent., or an annual increase of nearly 19 per cent. For the next five years the growth was only 9.5 per cent., or less than 2 per cent. annually; while there was a decrease of three-fourths of one per cent. in the five years from 1880 to 1885. In the last five years (1885 to 1890) there has again been a steady gain of 11.6 per cent., or 2.3 per cent. annually. These data are presented for the reason that all estimates of mortality must have for their basis a definite knowledge of the actual number of the population.

The remaining columns present the number of deaths in

each year as published in the registration reports of the State, the annual mortality rates also published in the same reports, and the corrected mortality rates. The usual method of stating the mortality rate has been to give the rate in census years, which gives a correct result for those years only, the rate being based upon the population as enumerated for that year. For the intervening years the same figures (those of the census years) were adopted as a basis in the registration reports. In the case of a rapidly growing town or city, however, this method is manifestly incorrect, since it is only adapted to a stationary population; and hence, if the city is increasing, the death-rate as thus stated for the four intervening years is too high, the excess over the actual rate being in proportion to the rate of increase of population and to the number of years which have elapsed since the preceding census. The discrepancy is therefore usually greater in the third and fourth years following a census than it is in the first and second. The error appears the most excessive in the years of most rapid growth. For example, the mortality rate of 1854, as stated in the registration report based upon the census of 1850, was 38.9. The actual population of 1854, however, was probably 14,550 instead of 8,283; which would reduce the death-rate of that year to 22.1, or but little more than one-half of the published rate of mortality. The effect of this method of computation was therefore to state the death-rate too high in twenty-eight years out of forty-two, and too low in three years; while in the remaining eleven years it was probably stated correctly. In some of the earlier years there were undoubtedly other errors in the published returns due to deficiency in the returns. The remarkable increase in the deaths of 1860 over those of 1858 and 1859 would also appear to indicate inaccuracy in the returns. The figures are as follows: deaths in 1858, 246; in 1859, 275; in 1860, 570, or more than double those of either of the two previous years, and although 88 persons lost their lives in 1860 by the fall of the Pemberton mill, this number would only partially account for the difference. It would appear that a portion of the deaths of 1858 and 1859 were held back and not returned till 1860.

Lawrence.—Mortality and Mortality Rates, 1848 to 1889.

YEAR.	Population.	Deaths.	Death-rates, Registration Reports.	Corrected Death-rates.	YEAR.	Population.	Deaths.	Death-rates, Registration Reports.	Corrected Death-rates.
1848, . .	5,949*	110	18.5	18.5	1873, . .	32,518	670	23.2	20.6
1849, . .	7,225*	174	24.1	24.1	1874, . .	33,717	734	21.0†	21.7
1850, . .	8,283	117	14.1	14.1	1875, . .	34,916	906	26.0	26.0
1851, . .	9,849	139	16.8	14.1	1876, . .	35,763	796	22.5	22.3
1852, . .	11,415	182	21.9	15.9	1877, . .	36,610	831	23.8	22.7
1853, . .	12,981	301	36.3	23.2	1878, . .	37,457	832	24.4	22.2
1854, . .	14,547	322	38.9	22.1	1879, . .	38,304	799	22.9	20.8
1855, . .	16,114	380	23.6	23.6	1880, . .	39,151	849	21.7	21.7
1856, . .	16,419	364	22.6	22.2	1881, . .	39,093	797	20.4	20.4
1857, . .	16,724	421	26.1	25.2	1882, . .	39,035	874	22.3	22.3
1858, . .	17,029	246	15.3	14.4	1883, . .	38,977	850	21.7	21.8
1859, . .	17,334	275	16.4	15.9	1884, . .	38,919	892	22.8	22.9
1860, . .	17,639	570	32.9	32.9	1885, . .	38,862	774	19.9	19.9
1861, . .	18,451	403	22.8	21.8	1886, . .	39,991	763	19.6	19.1
1862, . .	19,263	390	22.1	20.2	1887, . .	41,120	925	23.8	22.5
1863, . .	20,075	464	26.3	23.1	1888, . .	42,249	928	23.9	21.9
1864, . .	20,887	437	24.7	20.9	1889, . .	43,377	1,116	28.7	25.7
1865, . .	21,698	557	31.6	26.7					
1866, . .	23,143	513	23.6	22.1					
1867, . .	24,588	404	18.6	16.5	Total deaths, 42 years,		23,644	–	–
1868, . .	26,033	426	19.6	16.4					
1869, . .	27,477	361	16.6	13.1	Average mortality rate,		–	23.6	–
1870, . .	28,921	498	17.2	17.2					
1871, . .	30,120	565	19.5	18.8	Corrected average mortality rate, . .		–	–	21.2
1872, . .	31,319	689	23.8	21.9					

* Special enumerations made by the town. † By census of 1875.

The foregoing figures, presenting the mortality rate of Lawrence during nearly the entire period of its history, show that, so far as can be judged from the data presented, the health of the city compared favorably with that of the city population of the State taken as a whole. For the entire period the actual death-rate appears to have been 21.2 per 1,000. For the four census years 1870, 1875, 1880 and 1885 the average rate was 22.1, while that of the 23 cities of the State for the same years was 22.2 per 1,000. Boston had 24.5 for the same period (the highest), and Newton had 13.4 (the lowest).

The years in which Lawrence had an excessive death-rate were 1849, 24.1; 1857, 25.2; 1860, 32.9; 1865, 26.7; 1875, 26.0; and 1889, 25.7. As has already been stated there are reasons for believing that some of these data are incorrect (especially in the years 1860 and 1865) in consequence of the transfer of the record of deaths from the year in which they occurred to the following year. This, however, cannot be said of the year 1889 under the administration of better and more efficient registration laws.

Special Diseases having Sanitary Significance. — Turning now from the questions of the general mortality rate of Lawrence, let us consider the prevalence of special diseases of such character as serve to indicate to a greater or less degree the sanitary condition of the population.

For this purpose the following diseases have been selected, the greater part if not the whole of which may be considered as included in the commonly employed terms "zymotic," "infectious," "communicable" and "preventable." They are small-pox, measles, scarlet-fever, diphtheria and croup, typhoid fever, the diarrhœal diseases (dysentery, diarrhœa, cholera morbus and cholera infantum), consumption and pneumonia. The prevalence of these diseases is promoted by overcrowding, faulty ventilation, insufficient and improper food, impure water supplies, faulty drainage and sewerage, dampness; neglect of vaccination, isolation and disinfection; the presence of filth, and by occupations which expose to the inhalation of poisonous gases and irritating dust.

During the year 1889 the deaths from the diseases just mentioned were as follows: From small-pox, no deaths; measles, 2; scarlet-fever, 7; diphtheria and croup, 174; typhoid fever, 57; diarrhœal diseases, 116; consumption, 112; pneumonia, 71; cholera infantum, 96; measles, 5; diarrhœa and dysentery, 15.

These figures should be compared with the deaths from the same causes in Lawrence for a series of years, and also with those of the general population of Massachusetts for a similar period. The period selected for comparison is the previous eighteen years, beyond which time it would be difficult to obtain accurate data.

For convenience of comparison the mortality is expressed at a ratio per 10,000 of the living population, the population of the census year 1880 being taken as an average population of the eighteen-year period.

Deaths from certain special causes in Lawrence and in Massachusetts for the eighteen years 1871–88, and also for 1889.

	Small-pox.	Measles.	Scarlet-fever.	Diphtheria and Croup.	Typhoid Fever.	Diarrhœal Diseases.	Phthisis.	Pneumonia.
Deaths in Massachusetts, 1871–1888,	2,292	3,698	14,258	32,715	17,695	54,260	101,232	48,996
Lawrence, 1871–1888,	24	131	327	698	574	1,555	2,647	1,113
Annual ratio per 10,000.								
Massachusetts, 1871–1888,	.71	1.15	4.44	10.19	5.52	16.90	31.55	15.26
Lawrence, 1871–1888,	.34	1.86	4.64	9.91	8.14	22.07	37.57	15.79
Deaths in Lawrence, 1889,	–	2	7	174	57	116	112	71
Ratio per 10,000, 1889,	–	.46	1.61	40.11	13.14	26.76	25.82	16.37

By this table it appears that the mortality from small-pox in Lawrence for the period of eighteen years previous to 1889 was but .34 per 10,000 of the population annually, or less than half that of the State from the same cause. From measles it was equivalent to 1.86 per 10,000 annually, or about 60 per cent. greater. From scarlet-fever it was 4.64 per 10,000, or a little larger than that of the State. From diphtheria and croup it was 9.91 per 10,000, or a little less than that of the State for the same period. From typhoid fever it was nearly 50 per cent. greater than that of the State. From diarrhœal diseases it was more than 25 per cent. greater than that of the State. From consumption it was 20 per cent. greater than that of the State, and from pneumonia it was but little greater than that of the State.

For the year 1889 the list presents certain very notable differences from the foregoing figures. During that year there were no deaths from small-pox in Lawrence, and the mortality from measles and scarlet-fever was but slight when compared with that of the city or of the State for the previous eighteen-year period. On the other hand, the mortality rate from diphtheria was about four times as great as that of either the city or the State for the previous eighteen years. The mortality from typhoid fever was 138 per cent. greater than that of the State, and 61 per cent. greater than that of Lawrence for the previous eighteen years. The mortality from diarrhœal diseases in 1889 was 58 per cent. greater than that of the State for the previous eighteen years, and 21 per cent. greater than that of Lawrence for the same period. This mortality in 1889 consisted mainly of cholera infantum, the specific data being as follows: cholera infantum, 96; diarrhœa and dysentery, 15; cholera morbus, 5. There was a considerable decrease in the death-rate from phthisis, both as compared with that of the State and that of the city, and especially as compared with that of the city for the previous eighteen years, the actual difference being 22 per cent. as compared with that of the State and 45.5 per cent. as compared with that of the city for the previous eighteen years. It is to be noted in this connection that there has been a gradual decrease in the mortality from consumption throughout the State for the past thirty years, but not so

great as is shown by the record of Lawrence for 1889. The ratio for Massachusetts for the ten years ending with 1878 was 33.7 per 10,000 annually, while for the next ten years ending with 1888 it was 30.5 per 10,000 annually.

There was a slight increase in the mortality rate from pneumonia both over that of the State and that of the city. It should also be noted that there has been a marked increase in pneumonia in the State in recent years, from 13.88 per 10,000 for the ten years ending with 1878 to 16.71 per 10,000 for the ten years ending with 1888.

Local Conditions. — In the examination of different portions of the city with reference to their sanitary condition the Board secured the services of Dr. J. C. Bowker of Lawrence, who made a personal inspection of houses and localities. His report is presented on a later page.

Diphtheria prevailed in 1889 in certain tolerably definite localities having quite well-defined limits. These may be seen by reference to the map of Lawrence facing page 387.

As a basis of any accurate inquiry having reference to the prevalence of disease in certain districts, a census of the population living in such districts is desirable for the purpose of determining the following points: —

1. The morbidity of the population with reference to the disease in question; that is, the ratio of cases to the population occurring within a limited period.

2. The mortality, or the ratio of deaths to the population living in a district.

3. The lethality, or the ratio of deaths to cases.

It is possible to ascertain the latter of these points from the official records of deaths of the city clerk's office, the records of reported cases at the office of the local board of health, and the record of cases collected by Dr. Bowker in a house-to-house inquiry in the infected districts. The other points are not easily ascertained in consequence of the extremely migratory character of the population in some of the districts, especially in that which is bounded by Lowell, Amesbury and Essex streets and Broadway. Probably one-half of the entire population of Valley and Common streets, between Broadway and Amesbury Street, has changed within the past year.

Another important object of inquiry is to ascertain the conditions both natural and artificial which prevail in the infected districts. On examining the plan showing the location of reported cases and deaths there appears to have been a considerable difference in their fatality, — in one district being as low as 15 per cent., in another 25 per cent. and in another about 50 per cent. These localities were therefore selected and visited.

The region bounded by Lowell, Amesbury and Essex streets and Broadway is west of the common and between it and the Boston and Maine Railroad. The general level of these streets is above the level of the river at the dam. Their drainage is toward the portion of the river below the dam. In the neighborhood of Valley Street there was once a water-course, which has been filled so that the street is nearly level, the ground water being conducted away by a large drain or sewer. The soil in this neighborhood appears to be porous and sandy and the cellars comparatively dry. Wells are not generally used for water supply, but the public water supply is quite generally furnished in the houses upon these streets.

The houses on these streets are of wood; most of them are from ten to thirty years old or more, although they have the appearance of being much older. The prevailing style is that of a two or three story house, some with gable roofs and some with flat roofs, and containing from two to six tenements, and some have more. These tenements have from two to six rooms each. The rooms average about 8 feet in height and about 11 or 12 feet square, having an average of 1,000 to 1,200 cubic feet of air space. There are no special provisions for ventilation. The floors are generally old and much worn, the ceilings dingy and cracked. Walls sometimes painted, sometimes bare and some papered. Kitchen usually larger than other rooms, the sink draining to the sewer and in some cases provided with a simple S trap, but more often without a trap.

The population upon these streets is about two-thirds French Canadian and one-third Irish, and the size of families varies from 2 to 18 persons. Should think they would average 5 or 6 per family.

The privies of all these houses are of the out-door pattern provided with vaults and located in the back yards of the tenements, usually in groups of three, four, six or more, having a common brick vault, accessible sometimes in the rear, or at the side or end or through the floor of the privy, for the purpose of cleaning out. Many of them are loosely constructed of brick or stone; some without vaults. Some had been cleaned out recently, and a few not within two years. All of these privies, or nearly all, were provided with locks and keys and were kept locked; a provision which, while it might plainly have certain advantages, is also clearly open to objections, which the deposit of filth in the yards by persons unable to enter the privies made quite manifest. The yards were in some instances made the depositing ground for ashes, garbage and other filth.

The general characteristics of the people on these streets are those of a population overcrowded, ill-fed, badly clothed, poor, ignorant, neglectful and careless of all sanitary laws, especially as to those which relate to intercourse with other families at times of infection. As an illustration of the difficulty of dealing with those who are ignorant of the nature of infectious diseases, one mother, on being warned as to the danger of allowing her young children to play with the children of infected families, said, "It makes no difference; if my children are sick it is the will of God."

Examples.

No. 98. Family of Mr. C., with *two* adults and *three* children. Father and mother worked in mill. Age of children, 4 months, 1½ years and 3 years. The second child died of cholera infantum in August, the oldest (3 years) was taken with diphtheria and died in October, the youngest (4 months) was born since the death of the others. This family occupies 4 rooms, the average size of which is about 1,100 cubic feet. There are four tenements in this house communicating with the same general hallway. (The quarantining of houses so arranged, in case of a single case occurring in one tenement, is a matter of difficulty.) In the case of this family the mother, on going to her daily work at the mill, left her three-year-old child (then her only

living child, the youngest being still unborn) in charge of a neighbor. She now thinks that there had been a recent case of diphtheria at the house of this neighbor, and on inquiry afterward this was found to be the fact.

At No. 80 lives Mrs. D. (French Canadian). In this house are 15 children, of whom 3 had diphtheria. This family occupies 4 rooms and consists of 8 persons, 2 adults and 6 children. The ages of the children attacked in this family were 6 and 18, both in October last, and both recovered.

At house opposite lives Mrs. —— (French Canadian); 13 in her family. She had lived there but a few weeks only, and not during the diphtheria period.

At No. 122, house and shop, Mrs. —— (Irish). One death from diphtheria, aged 4 years. One other death of a child 9 months old occurred in the same house, upper tenement, a few weeks before.

Other marked characteristics of the population of this district are its poverty and its mobility. The question put to all as to duration of present residence was very often answered, "A few months only." The average length of stay in a tenement on Valley Street would scarcely exceed six months.

So far as unsanitary conditions are concerned abundant material was found for aiding the spread of disease. Another condition, however, appeared to be manifest which is of equal if not of greater importance as a causative factor; *i. e.*, intercommunication between the infected and the non-infected.

The territory bounded by Lowell, Warren and Essex streets, constituting another district, is on comparatively high ground, interspersed with hills; the character of the soil being mainly a fine gravel or sand, porous and dry. Wells here are usually deep and the water table far beneath the surface; and as a consequence cellars of houses are mostly dry. The people living on Warren Street and on the adjoining streets are mostly English, Scotch and American. The houses are for a large part single, detached cottages, with usually one or two tenements in each. These houses are mostly supplied

with the city water; they also usually have privies in the rear of the houses, of the same style as those in the Valley Street district. The houses are neat, quite well furnished, and in most cases families have from five to eight rooms in a tenement.

South of the foregoing is the Water Street district, which runs parallel with the Merrimack River on the north side above the dam. The houses on this street and in its immediate vicinity are comparatively new, some of them in blocks and others detached, but most of them are occupied by two families or more. The occupants are mostly Irish and English. The general location of this district is at a lower level than either of those described before, and there are several marshy tracts included in it containing stagnant water. The houses are mostly supplied with city water, but the privies are almost all of the outdoor pattern with vaults.

With reference to the remaining districts, that which is included in that part of Oak, Elm and Chestnut streets lying between Jackson and Hampshire streets, so far as its sanitary condition is concerned, is better than that of the Valley Street district. The same may also be said of that part of Ward 1 lying between Newbury and Garden streets and the Spicket River, and a portion of Prospect Street north of this river.

South Lawrence, which had about 100 cases and 28 deaths, has a varied population; the houses in some portions being of the better class, while in others, especially in that portion west of South Broadway, they approach the condition of the Oak Street district.

In order to ascertain more fully the causes and conditions prevailing in Lawrence in connection with the prevalence of diphtheria in 1889, the following investigation was made by Dr. J. C. Bowker early in the winter of 1890: —

In this investigation information has been derived from a threefold source: 1, official records; 2, statements of physicians; 3, personal inspection of infected premises. Notwithstanding many unreported but well-authenticated cases have come to the compiler's notice, it was thought best to include only such cases as were found on the records of the local board of health. The total number

of cases was 529; of deaths 168, about 31 per cent. Though the disease has existed in this city for several years, it did not assume alarming proportions until May, 1889. (See diagram on page 407.)

The last case in 1888 occurred in the eastern part of the city, at least a mile distant from the first case in 1889, which appeared on Tower Hill, at the extreme western limit of the city, in a girl of six years whose father is a shoemaker. Where she contracted it is unknown. The child died, and soon after her death several of her school-mates were stricken with diphtheria, which was possibly carried from the school-house to their several homes. Although it was relatively more deadly in certain localities, notably in the neighborhood of Water, Valley and Mechanic streets, it was apparently uninfluenced as regards its occurrence by altitude or confined to any one district, but exhibited a general distribution; and, while the houses of the better class were not exempt, its ravages were more evident in the poorer class and in thickly settled places where the land was either contiguous to a watercourse or was "made," — Valley Street, along which it was especially virulent, being thickly populated and laid out on filled land which obliterated the course of a brook. Lawrence is built on a sandy plain, hemmed in by an amphitheatre of hills whose water presumably finds its way into the Merrimack and Spicket rivers, which flow through the city, by filtering through this sandy plain which is thickly supplied with poorly built vaults. The accompanying map shows approximately the location of every reported case; recoveries being denoted by a circle (○) and deaths by a filled circle (●). (See map facing page 387.)

As shown by the map the group of cases bounded by Haverhill, Essex, Milton and Margin streets was large and the fatality comparatively small, about 15 per cent. This region lies on the easterly slope of the hill, from 50 to 150 feet above tide-water. The group of cases just below this hill, bounded by Doyle, Richmond, Melrose streets and the Merrimack River, where the altitude is only 50 feet, shows a much greater death-rate, the percentage being 25. These two localities are included in Ward 5, where the number of school children between five and fifteen years of age is 1,597.

In the personal inspection the writer has visited 506 dwellings, many of which for various reasons added nothing to the research. A hundred of these houses have been taken at random and their characteristics presented in tabular form. In Table A (50 houses) all the houses contained one or more cases of diphtheria in 1889. In Table B (50 houses) positive evidence was obtained that no case

TABLE A.—Showing Results of Personal Inspection of Fifty Houses in which Diphtheria has occurred in 1889.

Number of Case	Nationality of Parents	Occupation of Father	Age of Patient	Sex	Month of Illness	Character of Illness	Result	Provision for Ventilation	Street	Attendant at School	Disposal of Garbage	Trap in Sink	Water Supply	Condition of Cellar	Water Closet	Remarks
1	American	Brakeman	10 years	M.	July	Severe	Death	None	Lowell	Yes	Removed by city weekly	No	Well	Damp; often overflows	Vault	—
2	Irish	Laborer	1 year	F	July	Severe	Death	"	Chestnut	No	City	No	Well	Dry	Vault	—
3	Irish	Operative	2 years	F	May	Severe	Recovery	"	Brook	No	City	Yes	City	Dry	Vault	—
4	French	Operative	13 "	M.	October	Mild	Recovery	"	Valley	No	City	Yes	City	Damp	Vault	—
5	Irish	Machinist	14 "	M.	August	Mild	Recovery	"	Union	Yes	City	Yes	City	Damp	Vault	—
6	Irish	Shoemaker	4 "	M.	August	Severe	Death	"	Hampshire	No	City	Yes	City	Damp	In house	—
7	English	Carpenter	6 "	F.	July	Severe	Recovery	"	Warren	No	City	No	City	Dry and clean	Vault	—
8	American	Operative	10 "	F.	July	Severe	Death	"	Oak	Yes	City	No	City	Very damp and dark	Vault	—
9	English	Operative	5 "	F.	October	Severe	Death	"	Short	No	City	Put in after child's death	City	Dry	Vault	—
10	Irish	Laborer	7 "	M.	July	Severe	Recovery	"	Short	Yes	City	Yes	City	Damp and filthy	Vault	
11	French	Operative	6 "	M	July	Severe	Recovery	"	Valley	No	City	Yes	City	Damp and filthy	Vault	
12	Irish	Operative	4 "	M.	August	Mild	Recovery	"	Valley	No	City	Yes	City	Dry	Vault	
13	American	Operative	7 "	F.	September	Mild	Recovery	"	Methuen	No	City	Yes	City	Dry	Constant flow of water	
14	Irish	Laborer	5 "	F	August	Mild	Recovery	"	Valley	No	City	No	City	Damp, overflows in rains	Vault	
15	English	Shoemaker	6 "	F	January	Severe	Death	"	Lowell	Attended school for two days	City	No	City and well	Dry	Vault	Well water not used since previous October
16	Irish	Laborer	1 year	F	July	Severe	Death	"	Chestnut	No	City	Yes	City	Dry	Vault	—
17	English	Operative	1 "	F	October	Severe	Recovery	"	Water	No	Thrown in swamp at rear of house	Yes	City	Very damp	Vault	—
18	American	Bleacher	6 years	M	September	Mild	Recovery	"	Farnham	No	City	Yes	City	Dry	Vault	—
19	English	Agent	8 "	F.	August	Mild	Recovery	"	Water	Yes	City	No	City	Dry	Vault	—
20	Scotch	Machinist	9 "	M	September	Mild	Recovery	"	Farnham	Yes	City	No	City	Dry	Vault	—
21	Irish	Barber	6 "	F.	August	Severe	Death	"	Prospect	No	City	No	City	Damp	Within ten feet of house; soil	Marshy land back of house
22	Irish	Bricklayer	5 "	F.	July	Mild	Recovery	"	South Union	No	City	Yes	City	Dry	Vault	—
23	Irish	Laborer	14 "	F.	October	Severe	Death	"	Common	Yes	City	No	City	Damp	Vault	Filthy surroundings.
24	German	Operative	2	F	May	Mild	Recovery	"	Brook	No	City	Yes	City	Dry	Vault	—
25	French	Operative	1 year	F	July	Severe	Death		Valley	No	City	No	City	Damp	Vault	—
26	English	Machinist	1 "	M.	September	Severe	Death	"	Water	No	City	Into ground back of the house	City	Dry	Vault	—
27	Irish	Operative	10 years	M.	May	Severe	Death	"	Common	Yes	City	Yes	City	Damp	Vault	—
28	German	Shoemaker	4 "	F.	August	Severe	Death	"	Union	No	City	Yes	City	Dry	Vault	—
29	American	Physician	30 "	M.	November	Severe	Recovery	"	Jackson	No	City	Old plumbing	Private	Damp	Water closet	House in bad repair
30	American	Operative	5 "	F.	October	Mild	Recovery	"	Prospect	No	City	Yes	City	Damp	Vault	Near marsh lands
31	American	Operative	4 "	M.	October	Mild	Recovery	"	Newbury	No	City	No	City	Damp	Vault	—
32	Irish	Barber	4 "	M.	August	Severe	Death	"	Hampshire	No	City	Yes	City	Damp, overflows in rainy weather	Vault	—
33	Irish	Operative	1 year	F.	August	Severe	Death	"	Valley	No	City	Yes	City	Damp	Vault	—
34	English	Tinsmith	8 years	F.	June	Mild	Recovery	"	Warren	Yes	City	Yes	City	Dry	Vault	—
35	Irish	Junk dealer	5 "	F.	February	Mild	Recovery	"	Lowell	No	City	No	City	Damp and malodorous	Vault	—
36	American	Operative	2 "	F	September	Mild	Recovery	"	Farnham	No	City	Yes	City	Dry	Vault	—
37	English	Grocer	3 "	M	June	Severe	Death	"	Warren	No	Private disposal	Yes	Well	Dry	Vault	—
38	Irish	Operative	4 "	F.	September	Severe	Death	"	Warren	No	City	No	City	Damp	Vault	Premises in very bad condition.
39	Irish	Laborer	6 "	F	July	Severe	Death	"	Chestnut	No	City	No	City	Damp	Vault	Abounds in filth and dampness.
40	American	Physician	10 "	M.	October	Mild	Recovery	"	Haverhill	Yes	City	Yes	City	Dry	Water closet	Appliances efficient in every respect
41	American	Janitor	11 "	F.	September	Mild	Recovery	"	South Broadway	Yes	City	No	City	Damp	Vault	—
42	English	Butcher	7 "	F	July	Severe	Death	"	Park	Yes	City	Yes	City	Damp	Vault	Cess pool in immediate vicinity.
43	Irish	Laborer	1 year	F.	August	Severe	Death	"	Chestnut	No	City	Yes	City	Damp	Vault	Surroundings very filthy.
44	French	Operative	6 years	M.	August	Severe	Recovery	"	Lowell	No	City	No	City	Dry	Vault	—
45	English	Carpenter	6 "	F.	January	Mild	Recovery	"	Warren	No	City	Yes	City	Dry	Vault	—
46	German	Operative	5 "	M.	October	Mild	Recovery	"	Park	No	Thrown in lot in rear of house	Yes	City	Dry	Vault	—
47	Irish	Operative	4 "	F.	May	Mild	Recovery	"	South Union	No	City	Yes	City	Dry	Vault	—
48	American	Carpenter	9 "	M.	August	Mild	Recovery	"	Lowell	Yes	City	Yes	Well	Very damp	Vault	—
49	English	Operative	1 year	F.	May	Severe	Death	"	Berkeley	No	City	Yes	City	Dry	Vault	—
50	American	Carpenter	7 years	F.	October	Severe	Death	"	Park	Yes	City	Yes	City	Dry	Vault	—

In Table B (50 houses) positive evidence was obtained that no case

TABLE B. — SHOWING RESULTS OF PERSONAL INSPECTION OF FIFTY HOUSES IN WHICH DIPHTHERIA HAS NOT OCCURRED FOR FIVE YEARS.

Number of Case	NATIONALITY OF PARENTS	Occupation of Head of Family	Street.	Children Attendant at School or Not?	Special Means of Ventilation	Disposal of Garbage	Water Supply.	Condition of Cellar	Vaults and Water Closets.	Trap in Sink Pipe	REMARKS
1	English,	Operative,	Water,	No,	None	City,	City,	Slightly damp,	Vault,	Yes,	– –
2	United States,	– –	Jackson,	No,	"	"	City,	Dry,	Water closet,	Yes,	– –
3	English,	Mechanic,	Tremont,	No,	"	"	City,	Dry,	Water closet,	Yes,	– –
4	United States,	Judge,	Haverhill,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
5	German,	Peddler,	Park,	Yes,	"	"	City,	Dry,	Water closet,	No,	Closet in bad condition.
6	English,	Butcher,	Franklin,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
7	United States,	Tailor,	Park,	No,	"	"	City,	Dry,	Vault,	No,	– –
8	United States,	Mason,	Concord,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
9	United States,	Physician,	Bradford,	No,	"	"	City,	Dry,	Water closet,	Yes,	– –
10	Irish,	Operative,	Acton,	Yes,	"	"	City,	Damp,	Vault,	No,	Closets very filthy.
11	Irish,	Operative,	Lowell,	Yes,	"	"	City,	Damp,	Vault,	No,	– –
12	Irish,	Liquor dealer,	Amesbury,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
13	United States,	Carpenter,	Orchard,	No,	"	"	City,	Damp,	Vault,	No,	– –
14	United States,	Grocer,	Fairmount,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
15	United States,	Operative,	Farnham,	No,	"	"	Well,	Dry,	Vault,	Yes,	– –
16	Irish,	Stable man,	Common,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
17	United States,	Operative,	Methuen,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
18	United States,	Driver,	Auburn,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
19	Irish,	Operative,	Common,	Yes,	"	"	City,	Damp,	Vault,	Yes,	Filthy cellar
20	Irish,	Salo n keeper,	Essex,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
21	United States,	Grocer,	Lawrence,	Yes,	"	"	All drink milk,	Dry,	Vault,	Yes,	– –
22	United States,	Clerk,	Oak,	Yes,	"	"	City,	Damp,	Vault,	Yes,	– –
23	United States,	Teacher,	Garden,	Yes,	"	"	City,	Dry and airy,	Water closet,	Yes,	– –
24	English,	– –	Allen,	No,	"	"	City,	Damp,	Vault,	No,	Location very damp.
25	United States,	Machinist,	Chestnut,	No,	"	"	City,	Dry,	Vault,	No	Closet very dirty
26	United States,	Baker,	Franklin,	No,	"	"	Private supply,	Dry,	Vault,	Yes,	– –
27	English,	Tailor,	Cross,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
28	United States,	Clerk,	Franklin,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
29	Scotch,	Operative,	Union,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
30	United States,	Operative,	Canal,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
31	Irish,	Operative,	Lawrence,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
32	United States,	Operative,	Chestnut,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
33	Irish,	Laborer,	Haverhill,	No,	"	"	City,	Dry,	Vault,	No,	– –
34	French,	Operative,	Common,	Yes,	"	"	City,	Damp,	Vault,	No,	Filthy surroundings.
35	United States,	Cobbler,	Summer,	Yes,	"	"	City,	Dry,	Vault,	No,	– –
36	Irish,	Operative,	Spruce,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
37	United States,	Brakeman,	Broadway,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
38	United States,	Operative,	Pine	Yes,	"	"	City,	Dry,	Vault,	No,	– –
39	Irish,	Operative,	White,	Yes,	"	"	City,	Dry,	Vault,	No,	– –
40	Irish,	Laborer,	Maple,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
41	United States,	Operative,	Holly,	Yes,	"	"	City,	Dry,	Vault,	Yes,	– –
42	Irish,	Operative,	Myrtle,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
43	United States,	Clerk,	Broadway,	Yes,	"	"	Spring water,	Dry,	Vault,	Yes,	Ill-made vault
44	United States,	Operative,	Montgomery,	No,	"	"	City,	Dry,	Vault,	No,	– –
45	United States,	Florist,	West,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
46	United States,	Carpenter,	Florence Place,	No,	"	"	City,	Dry,	Vault,	Yes,	– –
47	United States,	Box maker,	Alden Court,	Yes,	"	"	City,	Dry,	Vault,	Yes,	Stable adjoining.
48	United States,	Operative,	Canal,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –
49	Irish	– –	Spruce,	Yes,	"	"	City,	Dry	Vault,	Yes,	Stable near.
50	United States,	Operative,	Methuen,	Yes,	"	"	City,	Dry,	Water closet,	Yes,	– –

of diphtheria had occurred in any one of them for at least five years previous to January, 1890. Owing to the migratory nature of a large portion of the city's population, the inquiry for this series was attended with much difficulty; but it is believed that this group corresponds with Series A in the closest possible manner as regards the character of the buildings, their locations and inhabitants. Table A represents all classes of dwellings, from those with the most approved plumbing and modern appliances to those with none at all, and was taken from portions of the city where the disease was most prevalent. In no house was there found any special means for ventilation. With only five exceptions the supply of drinking water was from the city reservoir or one of the springs adjacent to the city. . . . In these five cases water from the city supply *only* had been used for some months preceding the outbreak of the disease. In two instances only were proper water-closets discovered, and the vaults generally were of an antiquated type, built of brick or stone, sadly in need of repairs and inadequate to the demands, and in some instances so exceedingly filthy as to preclude the possibility of a thorough examination. It is a noteworthy fact that Table A shows but twelve American families (and by this is meant birth of parents in the United States) where the disease occurred, and only three of these were fatal. And Table B shows twenty-nine American families where the disease did not occur at all.

The corporation boarding-houses exhibited a singular immunity from the disease. These buildings, comprising over one hundred and seventy dwellings in blocks, are located on Methuen, Canal and Lincoln streets, extending from Broadway to Union Street. These blocks are all supplied with a system of sewers placed about 30 feet in their rear, through which a stream of water pours continuously and into which empty all the privies, drains and cesspools connected with these buildings. The sewers empty into the Merrimack River. A row of wooden houses on Newbury Street is not thus supplied with good drainage facilities, and in this row a case is said to have occurred. There are two children to every one of the corporation houses and an average of five children to every house on Valley Street, which is on the same level and where the fatality was something like 50 per cent. of all the cases occurring on this street between the limits of Amesbury and Broadway. This point is given especial consideration owing to the fact that nearly 95 per cent. of cases happened among children, the average age being 4 years and 11 months. The corporation houses are well constructed, cleanly and well cared for in every respect, and contain many tenants of all nationalities. The

Valley Street houses, west of Amesbury, are generally in poor repair, with oftentimes filthy surroundings, crowded with tenants, from four to six families in a house, mostly French Canadian mill operatives who pay small attention to sanitary conditions. Along Prospect and Mechanic streets the conditions are somewhat better, and the population largely tinctured with the German element. The district included between Jackson, Oak, Chestnut and Hampshire streets, where there were many children, many cases and 25 per cent. of deaths, is almost entirely occupied with Irish people; while the vicinity just south of this, where the proportion of children and cases were very small, is nearly all American, and the dwellings of the better class. This portion of the city, together with that bounded by Concord, Cedar, Hampshire and Broadway, where the element is likewise chiefly native born, suffered very slightly from the epidemic. The square bounded by Milton, Margin, Essex and Haverhill streets contains a large percentage of English and Scotch, and had a mortality of 15 per cent. The houses here are superior to those in the Valley Street region, and not huddled together so closely. The social intercourse was freely maintained among these families during the earlier period of the epidemic, and isolation of infected persons scarcely practised at all. The schools were not closed, but children from houses where the disease prevailed were kept from attending them though allowed to freely mingle with their classmates outside school walls. There was no quarantine against public library books, and volumes which had been exposed to the disease circulated among people who had suffered no previous exposure. Largely attended funerals were the rule among the French element, and "wakes" were frequent among the Irish until forbidden by the authorities about the first of November.

In the Mechanic Street section the houses stand on low ground, bordering the Spicket River, and are walled in on the east by Prospect Hill; here the fatality was nearly 30 per cent. In May the disease increased fifteen cases above those of the previous month, and this may be called the beginning of epidemic; from this time its spread was expansive, steady and fatal. The first of these cases occurred in light form in a boy of five years, who had lived in a house on Railroad Street, situated on a plot of damp land at the base of Cemetery Hill. He is said to have played with a lad who subsequently died with the disease, the latter also residing on Railroad Street, but whether he had been exposed is unknown. The next cases were on May and Bedford streets respectively, but between these and the two cases just named there had been no communication. Shortly after this the disease

appeared on Common Street, at its eastern end, and was followed by fresh outbreaks on Warren, Water, Oxford and Morton streets. The diagram shows, along with the meteorological conditions of

·DIPHTHERIA IN LAWRENCE IN 1889·

	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC	
AVERAGE TEMPERATURE. F.	31°	32°	36°	49°	61°	68°	71°	69°	63°	47°	41°	34°	
NUMBER OF FAIR DAYS.	14	15	12	13	11	10	11	15	8	13	11	14	147
NUMBER OF CLOUDY DAYS.	9	4	12	8	9	7	7	10	12	7	9	6	100
NUMBER OF RAINY OR SNOWY DAYS	8	9	7	9	11	13	13	6	10	11	10	11	118
PREVAILING WINDS.	S.W.	W. N.W.	E. S.E.	N.E.	W.	S.W N.W.	S.W. W.	N.W W.	E.	N.E. W.	W. S.W.	W.	
RAINFALL IN INCHES	5.21	1.65	2.03	4.12	4.33	3.43	7.04	3005	3 32	4.21	648	3.22	48 095 INCHES

REPORTED CASES. ------	5	6	9	8	23	38	45	71	60	89	89	86
DEATHS. ———	1	2	3	3	3	12	14	27	22	36	17	28
MONTHLY PERCENTAGE OF DEATHS TO REPORTED CASES.	20.	333	33.3	27.5	13 04	31.6	31.1	38	36.6	40.5	19.2	31

the year, the rise and fall of the epidemic, the dotted line showing the number of cases per month and the black line the deaths. The winds are expressed by their initial letter, and when they prevailed with much equality the dominant wind is placed above the other.

The month of July was one of incessant rain and great warmth, and furnished favorable conditions for the extension of the disease; which, with the exception of September, continued to increase until the maximum was reached in November. While the autumnal months are usually those when the disease flourishes

best, the diagram shows that in this case as early as May it began to grow in force, and July shows the large death percentage of 31 at a time when in other epidemics the disease has usually been at its ebb. Of 51 cases occurring before June 1 all but 6 were in Ward 5, which comprises that section of the city north of the Merrimack and west of Broadway. This area contains a large tract of marsh land and several pools of stagnant water, and has long been viewed with disfavor. Early in June the disease cropped out almost simultaneously on Carver, East Haverhill, Springfield, Short and Ferry streets, and before the month ended was so thoroughly scattered that its course could no longer be traced.

Personal inquiry from many of the prominent physicians of the city elicits the fact of their belief in the contagiousness of diphtheria, and that the spread of the disease was favored by excessive humidity and damp cellars, — Series A showing damp and dry cellars about equally divided while in Series B over 80 per cent. were dry and in good condition, — by filth, by inefficient provisions for quarantine, by public funerals and "wakes."

The proportion of children between the ages of five and fifteen in the various wards is as follows: Ward 1, 17 per cent.; Ward 2, 17 per cent.; Ward 3, 18 per cent.; Ward 4, 15 per cent.; Ward 5, 19 per cent.; Ward 6, 20 per cent.

The following table shows the location of fatal cases of diphtheria in 1889. The deaths from typhoid fever, cholera infantum and consumption are also introduced, since the prevalence of these diseases is largely influenced by certain sanitary conditions in common with diphtheria: —

Location of Fatal Cases in 1889 by Streets.

	Diphtheria and Croup.	Typhoid Fever.	Cholera Infantum.	Consumption.
Abbott,	–	–	1	–
Acton,	–	–	1	–
Alden,	–	–	1	–
Allen,	–	–	–	1
Ames,	–	–	–	1
Andover,	1	–	–	–
Arlington,	3	–	4	2
Atkinson,	1	–	–	–
Bailey,	–	–	1	–
Bennett,	–	–	–	1

Location of Fatal Cases in 1889 by Streets — Continued.

	Diphtheria and Croup.	Typhoid Fever.	Cholera Infantum.	Consumption.
Berkeley,	1	–	–	–
Bellevue,	–	–	–	1
Bodwell,	4	–	–	–
Border,	–	–	–	2
Bradford,	–	–	–	1
Broadway,	5	–	–	1
Butler,	1	–	–	–
Bunker Hill,	–	–	–	1
Canton,	1	1	–	–
Carver,	1	1	–	1
Cedar,	–	–	–	1
Centre,	–	1	–	–
Charles,	1	–	–	–
Chelmsford,	2	–	–	1
Chestnut,	8	1	2	9
Clinton,	–	–	1	–
Common,	3	3	7	9
Concord,	–	2	2	2
Crescent,	3	–	–	–
Cross,	–	–	1	1
Dairy,	–	–	1	–
Doyle,	1	–	–	–
Duck Corporation,	–	1	–	–
Durham,	1	–	1	1
East Haverhill,	1	–	–	–
East Oak,	1	–	–	–
Elm,	5	1	6	7
Essex,	1	2	2	2
Exchange,	–	–	1	1
Farnham,	1	1	–	–
Ferry,	2	–	2	1
Forest,	–	–	–	–
Foster,	1	–	2	1
Franklin,	5	1	3	1
Freeman Court,	1	–	–	–
Front,	1	–	–	1
Garden,	–	–	–	2
Hall,	1	–	–	1
Hampshire,	5	3	3	1
Hancock,	–	–	1	–
Haverhill,	7	4	–	5
High,	–	–	–	1
Holly,	1	–	–	–
Jackson,	4	1	–	–
Kimball,	–	–	1	–
Kingston,	1	–	–	–
Kempton Court,	–	–	–	1
Lawrence,	–	1	4	2
Lexington,	–	1	–	–
Lincoln,	–	–	–	1
Lowell,	5	1	8	3

Location of Fatal Cases in 1889 by Streets — Continued.

	Diphtheria and Croup.	Typhoid Fever.	Cholera Infantum.	Consumption.
Lowell Road, ...	1	–	–	–
Manchester, . . .	1	–	–	–
Maple, ...	1	1	1	1
Marston, ...	–	1	–	–
Margin, ...	1	1	–	2
Mason, ...	1	–	–	–
May,.	–	–	1	–
Mechanic, ...	4	–	–	2
Melrose, ...	1	–	–	–
Merrimac, ...	–	–	1	–
Methuen, ...	–	–	–	3
Melvin, ...	–	1	1	–
Middle, ...	1	–	–	–
Montgomery, . . .	2	–	–	–
Morton, ...	1	–	–	–
Newbury, ...	1	–	3	2
Nightingale Place, . .	–	–	1	–
Oak,.	6	1	4	3
Oxford, ...	1	–	–	1
Pacific Corporation,. .	–	1	–	–
Park, ...	4	3	1	2
Pine, ...	1	–	–	2
Pleasant, ...	1	1	–	–
Portland, ...	2	–	–	–
Prospect, ...	3	–	1	1
Railroad, ...	1	–	–	2
Riverview Place, . .	3	–	–	–
Salem, ...	3	–	–	1
Shattuck, ...	2	–	–	1
South Broadway, . .	2	1	–	1
Springfield, ...	6	–	3	3
Spruce, ...	1	–	1	1
Storrow, ...	–	–	–	1
Sumner, ...	–	–	–	1
South Union, . . .	3	–	1	–
Tremont, ...	1	1	1	1
Trenton, ...	–	–	1	–
Turner, ...	–	–	2	–
Tyler, ...	1	–	–	–
Union, ...	1	2	1	–
Valley, ...	15	3	13	2
Vine, ...	3	–	–	–
Walnut, ...	1	–	–	–
Warren, ...	2	–	–	–
Washington, . . .	–	1	–	–
Washington Corporation,	1	–	–	–
Water, ...	5	1	1	–
Webster, ...	1	–	–	–
West Parish Road, . .	1	–	–	–
White, ...	1	–	–	–
Willow, ...	3	–	2	1

Location of Fatal Cases in 1889 by Streets — Concluded.

	Diphtheria and Croup.	Typhoid Fever.	Cholera Infantum.	Consumption.
Winslow, ...	–	1	–	–
Woodland, . . .	1	–	–	1
City Almshouse, . .	–	–	–	4
City Hospital, . . .	1	9	–	3
Orphan Asylum, . .	–	1	–	–

Conditions prevailing in Different Districts.

In further inquiry with reference to the prevalence of diphtheria in Lawrence, certain conditions appear to have had a direct influence. These may be grouped in two classes, age distribution and sanitary conditions.

Age Distribution. — The age of the population has a very marked influence both upon the prevalence of diphtheria in a given community and upon the mortality from the same cause. Children under 5 years of age are not only more susceptible to the disease but it is more fatal among them than among adults. Hence, in a given population made up largely of young children, an epidemic of diphtheria, having once gained a foothold, is more destructive than it is in a community made up largely of adults. These differences in mortality are very striking. During the twenty-six years ending with 1888 the following figures expressed the mortality from diphtheria at different ages in Massachusetts: out of every 10,000 children under 5 years of age 36 died in each year from diphtheria; between 5 and 10, 19.3; between 10 and 15, 5.3; between 15 and 20, 1.7; between 20 and 30, .8; between 30 and 40, .6; above 40, .4.

These figures may be applied approximately to the two districts representing extreme conditions of age distribution in Lawrence. In the Valley Street district, children between the ages of 0 and 15 years constitute not far from three-sevenths of the population; and of this number about one-third are under 5 years, or one-seventh of the whole population of the district. In the tenements owned by the corpora-

tions, on the other hand, the ratio of children is comparatively small. In 20 corporation tenements, including 2 boarding-houses, the number of persons under 15 was but 20, or 10 per cent. of the whole population, and the children under 5 were only 6, or 3 per cent. These tenements are the property of the corporations, which not only control the renting of them but also impose certain conditions which tend to limit the birth-rate in such tenements. Hence the number of children in them is comparatively small. One of these earlier regulations has already been quoted. Another, which was published as late as 1866, provided that "the boarding of the two sexes in the same house can only be allowed by personal application to the agent;" and, while these rules are not enforced at the present day, the unwritten law undoubtedly has even now a marked effect in controlling the character of the population. Certain houses at the present time are occupied only by one sex as boarding-houses; and, while no census of the corporation houses has been made, there is not the least doubt that the average age of the population is much higher than that of other districts of the city. Hence the diseases of childhood are reduced to a minimum in such a population.

Sanitary Conditions. — The sanitary conditions of the Valley Street district have already been briefly described. In addition to those which have already been referred to, the accumulation or storage of filth in vaults in the neighborhood of inhabited dwellings, there is another equally prominent factor, — the density of the population, or the tendency to overcrowding; a condition which is invariably favorable to the spread of infectious diseases. This condition does not prevail in Lawrence to such a degree as is common in larger cities, especially in Europe. Dr. J. B. Russell states that 126,000, or about one-fourth of the population of Glasgow, live in one-room tenements, and the occupants average three to each room.*

The families of the Valley Street district occupy an average of 3.5 rooms each (139 persons, or 26 families,

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* "Life in one room," Glasgow, 1888.

occupied 97 rooms, or 1.4 to each room). One of the chief characteristics of infectious or communicable diseases is their tendency to spread from one individual to another. And this tendency is promoted or increases in proportion to the nearness of the infected to the non-infected.

The danger of spreading infectious diseases is much greater in a population of 100 persons occupying 50 rooms than among 100 persons occupying 200 rooms; the latter condition applying to the wealthier classes. Bad ventilation, or the absence of any proper means for renewing the air of apartments, is also decidedly favorable to the spread of disease; and this was found by Dr. Bowker to be very generally the case in the houses visited.

In the corporation houses the sanitary conditions are generally better, the population better fed, better housed, better clothed, and in general the conditions are such as to limit the prevalence of infectious diseases. In 18 corporation tenements, including 2 large boarding-houses, taken as an average of all, there resided 194 persons occupying 220 rooms, or an average of .88 per room. Eleven tenements had 10 rooms in each, five had 7 in each, one boarding-house had 42 and another 33. Excluding the 2 boarding-houses 18 families occupied 145 rooms, or an average of 8 rooms to each family. The following regulations are still posted in some of the houses, bearing date of 1866: "Every reasonable effort shall be made to secure the health, comfort and happiness of the boarders as in a well-ordered family. A strict regard shall be kept for neatness in and around the house, for ventilation, for bathing, for quietness and general good order."

The disposal of the waste of the corporation tenements, already mentioned, is undoubtedly conducive to the health of the tenants. The privies are in detached buildings, and the excreta are rapidly carried away by a constant stream of water, which also receives the household drainage of the tenements. This is not the case in all of the tenements.

Comparison of Conditions in the Valley Street District with those of the Corporation Tenements.

Valley Street.	Corporation Tenements.
Age Distribution.	
Children under 5 numerous. Average age of the population less than 20 years.	Mostly wage earners. Children under 5 few in number. Average age of the population about 25 years.
Density of Population.	
Population crowded in tenements having an average of 1.4 persons to each room.	Population less crowded.
Ventilation and Cubic Air Space.	
No special mode of ventilation. Rooms small, having an average of about 500 cubic feet to each person; and, when sleeping rooms only are reckoned, much less.	No special ventilation. Sleeping rooms larger.
General Condition of Houses.	
Bad. Many in poor repair. Rooms untidy. Filth in hallways, yards and alleys.	Good. Houses and their surroundings generally neat.
Disposal of Household Waste.	
Fecal matter almost invariably stored in vaults near the houses. Sinks generally discharging to sewer.	Household waste mostly removed by a constantly running stream of water. Sinks discharging to sewer.
Rules for Sanitary Government of Tenants.	
None.	Rules in some instances still in force. Old regulations still observed but not everywhere published.
Intemperance.	
Common. Dram shops frequent, interspersed among houses.	Not common.
Vaccination.	
Neglected.	Required by corporations for each new operative in mills. (This requirement also affects to a certain extent the population outside of the corporation houses.)
Prevalence of Diphtheria.	
Cases and deaths numerous.	Cases and deaths few.

In conclusion: the prevalence of diphtheria in Lawrence, after it had once gained a foothold, appears to have borne a more or less direct relation to certain conditions in proportion to their prominence in the districts which were invaded. The chief among these were the age distribution, — the ratio of young children to the general population being a controlling factor, — the density of the population, method of disposal of household wastes, absence of ventilation, general condition of houses with reference to cleanliness, and care as to isolation of the sick from the well. General neglect of the latter precautionary measure by the inhabitants of the Valley Street district appears to have been a prime cause of spreading diphtheria in that part of the city.

HEALTH OF CITIES AND TOWNS.

The following abstracts have been made from such reports of local boards of health as have been forwarded to the office of the State Board: —

Abington.

The character of a large number of the complaints which have been passed upon by the Board during the past year compels it at this time to call the attention of the town to the need of a thorough and uniform system of drainage. The introduction of water into the town has brought with it the co-existent necessity of an effectual means of carrying it off after it has been put to the manifold purposes to which the system is adapted. If the Board can accurately judge by the cases reported by physicians, the town has never had a year more free from contagious disease than the last, scarlet-fever and diphtheria in particular being almost unknown.

Attleborough.

The introduction of water works, although temporarily benefiting the health of a community, eventually increases the danger unless it is accompanied by a complete system of sewerage. The example that nature affords us, of supplying with every artery that carries pure blood to the various organs of the body a vein in which the impure blood returns, should be followed by every community when it introduces a system of water supply. Until better sewerage is established especial pains must be taken in the construction and care of all cesspools, vaults and out-houses. Soil that has become infiltrated and saturated with decaying organic material is dangerous to the health, and remains so even after more perfect sanitary systems are adopted. Chemical examination shows a slight and gradual increase of impurity in the public water supply, and the same reasons that prompt one to discon-

tinue the use of a private well in the midst of a populous centre would apply to a well for public use. While we continue to drink its water we should take all precautions to prevent its contamination. There is greater progress in this direction during the past year than has been made before since the water works were established, but more yet remains to be done. The rapid growth in population on Capron's Hill is an increasing source of danger. Until proper sewerage is afforded in this region all vaults should be constructed water-tight and carefully prevented from running over. It is of doubtful propriety to allow the existence of a slaughter-house in close proximity to dwellings.

Ayer.

There have been 32 deaths in the town during the year. No disease has been generally prevalent during the year. Two deaths have been reported as caused by diseases considered contagious, one each from diphtheria and typhoid fever. There have been reported to the board 8 cases of diphtheria, 17 of typhoid fever and 4 of scarlet-fever. Of the 17 cases of typhoid fever 3 were imported; the 14 remaining cases occurred in eleven families, occupying as many houses. All of the cases of typhoid fever were reported during the months of August, September, October, November and December, — the part of the year when the disease is known to be most prevalent, — and were reported as occurring in houses where well water is used, none originating in houses where the town water had been introduced for domestic purposes.

Belmont.

There have been 24 cases of contagious diseases reported during the year: scarlet-fever, 10; diphtheria, 3; measles, 11. One case of scarlet-fever proved fatal.

Beverly.

The whole number of cases of diphtheria reported, 3, and one death; scarlet-fever, 16; scarlatina, 10, — whole number, 29. No deaths from scarlet-fever or scarlatina. Your board of health thinks that the time is near at hand when Beverly will require a system of sewerage, as the surface of the ground is becoming more and more saturated every year with sewage from vaults and cesspools.

Boston.

The deaths during the year numbered 10,259 compared with 10,197 in 1888, making the death-rate for the year 24.42, reckoning the present population of the city at 420,000.* This is a high rate, but it is necessary to analyze the list of deaths and their causes in order to see how far sanitary administration can be held responsible for this record.

Of the 10,259 deaths during the year it will be seen by the tables that but 1,968 are due to causes which are generally classed under the head of preventable diseases. That is to say, 19.18 per cent. of the total deaths were from zymotic diseases while 80.82 per cent. were from other causes. There were 1,431 deaths from consumption, 938 from pneumonia, 448 from bronchitis and 789 from heart disease. These, together with the deaths from violent causes, old age, Bright's disease and cancer, account for nearly one-half the total number of deaths. Of the deaths from preventable causes, diphtheria was the cause of the largest number, there having been 564 deaths from this disease and 450 from cholera infantum. The death-rate among children under five years of age was 35.41 per cent. against 35.2 the previous year, but still a comparatively low percentage of the total mortality.

There has been no epidemic in the city during the year, excepting that of influenza, which had become alarmingly prevalent at the close of the year, the deaths for the last week of December exceeding those of any other week of 1889.

Small-pox, from which the city has been almost entirely exempt for a long period, reappeared in October at the North End. An Italian arrived here by way of New York from Italy, and a fortnight subsequent to his arrival five members of his family were found to be suffering from small-pox. A careful investigation gave conclusive evidence that the father had conveyed the disease to his children, he having been afflicted with it on his arrival here. Nine cases followed this one, and there is every reason to believe that they all had their origin in this importation. Nearly all these cases of small-pox were found in crowded tenement houses. By prompt attention, however, it was prevented from spreading and was soon wholly suppressed.

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* The census of 1890 shows that this estimate was not sufficiently high. Hence the mortality rate was probably less than that which is stated.

Infectious Diseases reported to Board of Health.

	Small-pox.			Diphtheria.			Scarlet-fever.			Typhoid Fever.		
	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.	Cases.	Deaths.	Per Cent.
1889, .	10	2	20.0	1,814*	564	31.09	464	23	4.96	1,071†	186	17.37

* Of these cases 20 were brought into the city.
† Of these cases 48 were brought into the city.

Result of Examination of Houses where Diphtheria was reported to exist.*

Ward.	Mistake in Report made by Physician.	Defective Sanitary Condition.	Premises in Good Sanitary Condition.	Other Cases.†	Total.	Fatal Cases.
Total, ...	17	782	770	225	1,794	564‡

* Number of cases reported, 1,814.
† The figures in this column show the number of places where premises were examined prior to receipt of notice of diphtheria. About 75 per cent. of this number were found to be in bad sanitary condition.
‡ Twenty cases reported from outside the city.
Two hundred and thirty-eight deaths occurred at the Boston City Hospital.

The deaths from diphtheria in Boston for the past thirty years have been as follows: —

1860, . . .	1	1870, . . .	51	1880, . . .	588
1861, . . .	17	1871, . . .	39	1881, . . .	601
1862, . . .	46	1872, . . .	28	1882, . . .	458
1863, . . .	108	1873, . . .	59	1883, . . .	445
1864, . . .	118	1874, . . .	72	1884, . . .	345
1865, . . .	51	1875, . . .	420	1885, . . .	334
1866, . . .	52	1876, . . .	577	1886, . . .	329
1867, . . .	47	1877, . . .	364	1887, . . .	316
1868, . . .	67	1878, . . .	448	1888, . . .	470
1869, . . .	61	1879, . . .	391	1889, . . .	564

The disease has not been confined to any particular locality, but has been very generally disseminated throughout the city. It is an interesting fact that the disease has not been particularly prevalent in the crowded and imperfectly drained portions of the

city, but has been fully as prevalent where the sanitary conditions are comparatively good. This would seem to prove that crowded tenements, imperfect drainage and poor hygienic surroundings, although important factors in causing the prevalence of the disease, are not the whole cause, but that contagion, not only from the severe cases but from mild and unrecognized forms, is the most important factor. The history of various epidemics in different cities bears out this statement. It is interesting to note that the average age of the patients has been six years, which fact has an important bearing upon the isolation or removal to hospitals. It very frequently happens that a child a year old will be ill with the disease and the mother is willing to go with it to the hospital if suitable provision could be made for the other children. Unfavorable comment has frequently been made that the board of health has not so effectually dealt with diphtheria as it has with small-pox. It must be borne in mind, however, that in the case of small-pox we have the protective power of vaccination. In spite of the endeavors of the board of health to have cases of diphtheria removed to the city hospital, only 347 out of the 1,814, or about 1 in 5 of the reported cases, have been induced to go.

In order to effectually deal with an epidemic of diphtheria, the following things are absolutely necessary: First, a good hospital, this the city has; second, what might be termed a house of refuge, where all who had been exposed to the disease might be placed for a reasonable time; third, a building in which convalescents could be placed during the process of disinfection of their houses; fourth, a careful medical supervision of the schools, for it is an undisputed fact that many children attend school while they are suffering from the disease in a mild form, and communicate diphtheria to other children; fifth, power to remove these cases in tenement houses, — not only the legal power but also that which is of fully as great importance, the moral support of the community; sixth, the prompt report of cases, not only of diphtheria but also of membranous croup, which is conceded by the best medical authorities of the present day to be the same as diphtheria; seventh, the prohibition of public funerals in cases of diphtheria. The report of cases is evaded in many ways by using the term "laryngitis" and various other terms, which, if not absolutely incorrect, serve to mislead not only the friends of the patient but also the general public.

Disinfection.

The table below shows the number and character of the places that have been treated with disinfectants during the year: —

DISINFECTION.	Total.
Streets,	259
Places,	591
Courts,	424
Alleys,	2,245
Yards,	12,913
Vaults,	13,904
Cellars,	9,052
Cesspools,	8,394
Gutters,	4,737
Water-closets,	7,364
Passageways,	4,545
Urinals,	431
Vacant lots,	1,119
Filthy sheds,	7,152
Filthy and infected rooms,	2,668
Sinks,	11,035
Total,	86,833

The following table shows the number of rooms disinfected in which contagious diseases have occurred: —

	Total.
Diphtheria,	1,315
Scarlet-fever,	289
Typhoid fever,	7
Measles,	4
Small-pox,	5
Schools,	4
Vacant houses,	2
Day nursery,	1
Infected bedding and clothing,	13
Infected carriage,	1
Total,	1,641
Number of rooms,	4,013
Pounds of sulphur used,	21,160

School-houses.

All of the public school-houses have been examined and re-examined, and their sanitary defects reported to the superintendent of public buildings, and in many instances the drainage and ventilation have been improved.

Owing to the occurrence of several cases of diphtheria among the pupils of a school located in the best section of the city, and the fact that the parents of the school children in this section felt apprehensive that the cause of the disease would be found in a defective condition of the drains and other sanitary appliances of this school-house, directions were given to close the school and tear up the drains, and an order was introduced in the board of aldermen requesting the board of health to examine into the sanitary condition of all the school-houses and report through the press. The drains of this building, when exposed, were found to be as tight and sound as when laid fourteen years ago. It should be said in this connection that the bad sanitary condition of the school-house may bear no relation to the number of cases of diphtheria among the school children of the district, and that a mild unrecognized case among the pupils, with the close contact which takes place with such children, is a very frequent cause of the spread of the disease. The removal of the old and substitution of a new drain in this case, however, served a good purpose in removing a doubt as to the condition of the drainage of this building and in restoring to the school many children who had been withdrawn. Under the order of the city council, the board of health felt warranted in considering not only the condition of the drainage but the questions of ventilation, overcrowding and the surrounding area for light and air.

Brockton.

The total number of deaths in the city during the past year was 409. Diphtheria has been quite prevalent the past year, though not confined to any particular locality. In June several cases occurred in the Centre and Park Street schools, and it was thought best by the board to order those schools closed; closing them one week earlier than the other schools. The rooms were thoroughly fumigated by the board. The physicians have reported the cases more promptly this year than ever before. The health officer visits the premises as soon as a case is reported, looks after the sanitary arrangements and posts the following notice: —

NOTICE.

This House contains a Case of

DIPHTHERIA.

When the Danger is passed this Notice will be removed by the Board of Health.

The following shows the number of contagious diseases reported during the year: diphtheria, 84; scarlet-fever, 12; measles, 9, — total, 105.

The records show 455 nuisances investigated and reported during the year, mostly defective cesspools and vaults.

Situated as Brockton is your board believes there are but two ways to dispose of the sewage of this city, — by taking it to tide-water or by purifying it by chemical precipitation or intermittent filtration. The plan of taking it to tide-water would be too expensive for this city to undertake alone. If the towns along the line of the main sewer were thickly settled a general system might be established in the same manner as proposed for the Mystic and Charles River valleys, the State to appoint a commission to carry out the plan and assess their proportionate part on the different towns along the line of the main sewer. But the towns along the line where the main sewer would have to be built are not yet densely populated enough to demand a system of sewerage, and may not be for many years to come, and we must look for some other means for the present disposal of it. It seems to your board that the only plan left for consideration is either that of precipitation or filtration.

Brookline.

There have been reported during the year ending Dec. 31, 1889, 3 cases of scarlet-fever, 11 of diphtheria and 4 of typhoid fever. The whole number of deaths within the town was 176. There were 5 deaths from diphtheria, 1 from scarlet-fever, 1 from typhoid fever and 2 from whooping-cough.

Cambridge.

Complaints and nuisances investigated during the year, 2,054. Number of inspections made, 2,271; number of subsequent inspections, 1,947, — total, 4,218. Vaccinations and re-vaccinations, 291; rooms fumigated, 145; number of notices for treatment of contagious diseases sent out, 481; number of visits to premises where contagious diseases occurred during the year, 529.

The increase in the number of inspections, 427, was largely due to the increased prevalence of diphtheria. The number of nuisances shows a general decrease, mainly due to the fact that the orders of the board have usually been promptly complied with.

The board would renew its recommendation of last year for a patrol of Stony Brook and its tributaries. The nuisance caused by the odors emanating from Niles's slaughter-house continues. This odor arises in the preparation of a fertilizer from the blood

and scraps of the slaughtered hogs. At present this appears to be the best method for the disposal of these substances. There is no radical remedy short of the removal of the establishment, which should never have been allowed to occupy its present situation.

The increase throughout the city of tenement houses and so-called "hotels" cannot be viewed with favor from a sanitary point. A large number of persons, many of them children, dwelling in one building, having entrances, passageways and staircases in common, and possessing free access to each others' apartments, supply the readiest means for the importation and dissemination of contagious diseases. Many of the inmates of these places are persons who know little of the measures necessary for the preservation of health, and frequently care less for them. In the event of the outbreak of a serious epidemic these places might prove hot-beds of infection. Alarm may have been roused in some minds by the published statements that epidemics of influenza are apt to be followed by Asiatic cholera. There appears to be no sufficient evidence for belief in a casual connection between these diseases. Alarm is never necessary. Vigilance is always necessary. Scrupulous cleanliness, both personal and of the surroundings of dwellings, is one of the most powerful factors in the preservation of health, and is a great safeguard against the effects of disease, endemic and epidemic.

The number of deaths in Cambridge during 1889 was 1,356. Compared with 1888, diphtheria shows an increase of 129 cases and 45 deaths; typhoid fever an increase of 35 cases and a decrease of 2 deaths; scarlet-fever a decrease of 33 cases and a decrease of 15 deaths. The total number of deaths occurring in 1889 was 11 less than in 1888. There were during the year 351 cases of diphtheria and 104 deaths, giving a case mortality of 29.6 per cent. As diphtheria is a very contagious disease the most efficacious means for the limitation of its prevalence is strict isolation. This appears to be in many instances, where the patients remain at home, an impossibility. In 37 houses there were 2 cases each; in 15 houses, 3 cases; in 11 houses, 4 cases; in 1 house, 5 cases; in 2 houses, 6 cases. Being so contagious, and the milder forms being regarded sometimes as simple sore throat, great care should be used in allowing persons to use articles in common. In some schools it is customary to interchange the books and pencils among the pupils. Every one must be familiar with the childish practices of putting the pencil in the mouth and of wetting the finger with saliva to turn over the page of a book. This book or pencil, passed to another child, may be the means

of spreading disease. Sanitary inspection of the premises where the disease was most prevalent showed them to be, in a great majority of instances, in a satisfactory condition. There was, however, a good deal of personal uncleanliness and disregard for the isolation of the cases. Of the 200 cases of typhoid fever reported during the year 7 originated in other places and should not be credited to Cambridge. There were during the year 116 cases of scarlet-fever reported. The number of deaths was 7, giving a case mortality of 6.03 per cent. In 9 houses there were 2 cases each, in 6 houses 3 cases each, in 1 house 4 cases.

Canton.

There have been reported by physicians 5 cases of diphtheria and 4 of typhoid fever.

Chelsea.

The total number of deaths for the year is 614, — 5 less than the year previous. There has been a decrease in the number of deaths from what are termed preventable diseases from that of the previous year. Last year there were 48 deaths from diphtheria, scarlet-fever and typhoid fever; this year 31, — a decrease of 17.

Fifty-six cases of diphtheria, 20 cases of scarlet-fever and 31 cases of typhoid fever have been reported during the year.

Chicopee.

Complaints and nuisances which have been investigated during the year, 912. The complaint "no trap under sink" occurs 320 times. This defect in plumbing has been carefully investigated and examined by the board, with the result that they have insisted on its being remedied. The trap is not only desirable but necessary, whether the discharge be into the sewer or otherwise. Two hundred and seventy-six deaths occurred in the town during the year 1889.

Clinton.

Contagious and infectious diseases for the year ending Feb. 1, 1890: the number of reported cases of diphtheria was 6; scarlet-fever, 18; measles, 6; cerebro-spinal meningitis, 2; typhoid fever, 33, — total, 65. Deaths therefrom were as follows: diphtheria, 2; measles, 1; cerebro-spinal meningitis, 2; typhoid fever, 2. Twelve out of the 33 cases of typhoid fever occurred in two families of a tenement block, both of which used water from the same well. The board was satisfied that the disease resulted from

drinking the water of this well, and forbade its use for drinking or culinary purposes. The block is now supplied with town water and the disease has disappeared.

Concord.

In May and June a careful inspection was made by the agent in the more thickly settled portions of the town, and all defects reported by him that seemed to be within the province of the board to deal with were ordered to be rectified, in many cases the chairman having visited the spot with the agent. It was gratifying to find that more general attention had been paid to measures of health and cleanliness by householders, and that suggestions and orders were more readily complied with than in former years. Two hundred and seventy-three houses and 336 families were visited, the tenement houses needing especial attention. There was one hearing held and one prosecution. Eight houses in which contagious diseases had occurred were thoroughly fumigated and two vaults disinfected by the agent. Red flags were put on houses where cases of scarlet-fever existed, and families were instructed in necessary precautions. Although 11 cases of scarlet-fever, 6 of measles, 1 of diphtheria and 11 of typhoid fever were reported to the board in 1889, there has been no death from any of these diseases, which have been mild in character and, we believe, have been much controlled in their spread by the precautions taken. Care was taken to keep children with whooping-cough out of the schools.

It seems to the board that an inspection of the out-lying houses and premises would be desirable during the ensuing year, as it is certain that much would be found in their condition dangerous to health. Concord being a "milk town," it seems to us important that producers and consumers should be informed that a circular has been sent to us by the State Board of Health in which special attention is called to the recent discoveries that tuberculosis and typhoid fever can be communicated in milk to human beings; the first disease from the cow, the second through tainted water used in washing the cans. The same circular dwells on the importance of giving cattle proper sanitary conditions and of seeing that their water supply is untainted. If possible, copies of this circular will be distributed among the citizens.

Cottage City.

Physicians have reported to the board 12 cases of measles and 1 of diphtheria. The number of cesspools and vaults that have been built are in excess of any previous year.

Easthampton.

During the past year, mostly since December 7, 12 cases of scarlatina have been reported to the board of health; none of which, however, proved fatal. Of diphtheria 31 cases have been reported and 8 known cases not reported. If any cases have been negligently or intentionally concealed in violation of the laws of this Commonwealth, thereby obstructing the board of health in the performance of its duty to prevent the spread of infectious diseases, the responsibility is not with them. Thirteen cases of diphtheria, or 33⅓ per cent. of all known cases, proved fatal. There seems to be no particular locality which has been more infected than the rest, nor any particular cause for this disease excepting sink drainage. In many instances negligence in the care and disposition of sink drainage has produced a nuisance, source of filth and cause of sickness. We would earnestly recommend that the subject of sewers be investigated, and that they be extended as fast as possible until every habitation can be drained.

Everett.

The number of complaints attended to the past year is 299 as compared with 420 the year previous. Diphtheria has been less prevalent than last year and less fatal. Most of the cases occurred during the early part of the year. Whole number of cases reported, 107; which may be classified as follows: due to unsanitary conditions, 62; to contagion, 13; to causes not positively known, 32. The premises where the disease occurred were inspected and put in proper condition, so far as possible, whenever necessary. That 57 per cent. of the cases were plainly traceable to unsanitary causes clearly shows the need of such inspection. Quite an extensive epidemic of measles prevailed in the spring, but it was very mild, a large number of those attacked not requiring the services of a physician. It is quite probable not all the cases were reported. Cases reported, 43. In the fall scarlet-fever broke out in five or six different parts of the town almost simultaneously, and has prevailed to quite an extent. Most of the cases have been light, however, only two deaths occurring therefrom during the year. Cases reported, 63. Typhoid fever caused but one death out of the 35 cases reported, — a very favorable showing. Eighty-seven permits have been issued by the board for children to attend school after the occurrence of contagious disease. We have good reason to believe, judging from the experience of other places, that when a sewerage system is fairly completed, it will diminish our present death-rate still lower and lessen the prevalence of many diseases.

Fall River.

Number of nuisances abated, 1,293; complaints received and investigated, 375; notices sent to abate nuisances, 302; second notices sent to abate nuisances, 56; notices sent to enter sewers, 65; tenements ordered vacated, 4; inspections made by inspector, 5,312; rooms fumigated after contagious diseases, 68; notices for treatment of contagious diseases sent out, 260; visits to premises where contagious diseases have occurred during the year, 633. A new small-pox hospital is recommended. We have submitted for the consideration of the city council a code of proposed regulations concerning plumbing and house drainage, and we recommend that the same be accepted.

The number of cases of contagious diseases reported to the board of health for the year 1889 was 633 against 566 in 1888. The total number of deaths for the same diseases was 103 against 127 in 1888. Diphtheria: there were 42 cases reported and 15 deaths against 46 cases and 17 deaths in 1888. Scarlet-fever: there were 185 cases reported and 34 deaths against 253 cases and 56 deaths in 1888. Typhoid fever: there were 258 cases reported and 46 deaths against 203 cases and 34 deaths in 1888. Measles: there were 248 cases reported and 8 deaths against 65 cases and 11 deaths in 1888. The whole number of deaths in the city was 1,462. Cholera infantum caused 168 deaths, or 11.49 per cent. of all deaths; typhoid fever is credited with 49 deaths, or 3.35 per cent., and scarlet-fever caused 34, or 2.32 per cent., of the total mortality. There were 3 deaths from hydrophobia.

Gardner.

Nuisances abated during the year, 127. Dangerous diseases reported: scarlatina, 4; typhoid fever, 11; scarlet-fever, 3; diphtheria, 18; measles, 8.

Great Barrington.

The town has been remarkably free from contagious diseases during the past year. The records show that in only two instances has scarlet-fever occurred, — one case in this village, the others in one family in Housatonic; all of which have recovered. One very mild case of diphtheria occurred in this village. Measles has prevailed quite extensively for the last month throughout the town, but no fatal cases have occurred. With the exception of epidemic influenza, which prevailed universally, the health of the town might be said to have been excellent during the year; very little malaria has been observed, and we have enjoyed a remark-

able immunity from cholera infantum and other intestinal disorders which frequently prevail in other parts of New England during the heated term.

Gloucester.

More attention has been given to the permanent abatement of nuisances than previously; any nuisance which was found to exist after having been abated for a number of times was considered to need special attention on the part of the board. The location of some nuisances is such that no means are at hand for their total disappearance; the introduction of a sewerage system would render the abatement of some of them easy, other sanitary improvements would abate others. Upon complaint of neighboring residents the board investigated the works of the Russia Cement Company, at which the manufacture of liquid glue from fish waste is conducted. To sum up the results of the investigation, the board states as follows: The odors are more marked in warm weather because the conditions for putrefaction are more favorable. There is apparently no stage in the manufacture of fish glue as ordinarily carried on in which sufficient odor is evolved to warrant any interference, but the waste water, which as it is discharged from the building does not contain odor, may under certain conditions generate an odor, and the waste water from these works is received into a small closed pond, from which it is allowed to escape at certain periods through a long, narrow channel located in certain marsh lands, and then enters the Annisquam River, so called, and the contents of the pond at such times gives evidence that they are not free from odor. As to the question whether chum can be converted into one of the ingredients of fertilizer without the production of odor your board will not decide, but wishes to call attention to the fact that analogous processes in other cities have greatly disturbed the public mind and have led to restrictions being placed upon them.

Typhoid fever caused 2 deaths as compared with 8 in 1888, 4 in 1887, 5 in 1886, 4 in 1885. Returns of cases are made to the board. The number returned was 17 as compared with 50 cases the year previous; these being the only years in which returns have been made. The falling off in the number returned is due to an absence of cases and to carelessness in making returns. Diphtheria caused 1 death; the number of cases returned to the board was 25 as against 25 in 1888, with 1 death, the figures being the same for both years. Scarlet-fever did not cause a single death; there were 53 cases returned to the board. The type of the disease was mild, most of the cases possessing none of

the more marked symptoms of the disease, which is a strong contrast with the previous year (1888), when, although there were few cases, there was a large proportion of the severest type of the disease. This disease is propagated by carelessness.

Haverhill.

The deaths for the year numbered 418 against 482 for the preceding year; a decrease of 64. It is gratifying to be able to show a continued falling off in the mortality of children under five years of age, which is another standard by which to judge of a city's sanitary condition; the percentage to the total mortality being 29.18, as compared with 33.88 for 1888, and those who died under the age of one year were 80, or 19.13 per cent.

The year 1889 has been signalized by a wide-spread epidemic of measles, which made its appearance at the beginning of the year and prevailed very extensively up to the middle of July. Two hundred and ninety-seven cases were reported by the physicians; and there were many more that were not reported, on account of no physician having been called to them. The prevalent notion that measles is a harmless disease, and that every child must have it sooner or later and the earlier it has it the better, has placed the board of health at a great disadvantage in trying to prevent its spread. This idea is based upon entirely false notions; exposure to measles should be avoided as carefully as to any other contagion. During the year it caused 12 deaths, a greater mortality than from diphtheria and scarlet-fever combined. Nor do these figures express its true mortality, as it was undoubtedly the primary cause of quite a number of deaths attributed to pneumonia, bronchitis and convulsions. Diphtheria was the cause of 5 deaths out of 22 cases reported; of 21 cases of scarlet-fever in the city one only proved fatal, and 40 cases of typhoid fever were reported with 8 deaths. The custom of placing warning cards on houses in which there are cases of diphtheria and scarlet-fever has been a very important measure, and has met with no opposition. The physicians of the city have given it their unqualified approval, and have also shown a most kindly disposition to assist the board of health in its work.

Number of cases of contagious diseases reported: Diphtheria, 22; deaths, 5. Scarlet-fever, 21; death, 1. Typhoid fever, 40; deaths, 8.

Regular flushing of sewers is recommended and better modes of garbage disposal. The board also suggests important changes in the sanitary condition of school-houses, having special reference to plumbing and ventilation.

Hudson.

Number of cases of contagious diseases reported to the board during the year is as follows: Diphtheria, 14; scarlet-fever, 3; measles, 7, — total, 24. During the closing months of the past year diphtheria has prevailed quite seriously through the town, and in several cases has proved fatal.

Hyde Park.

For the year ending Jan. 31, 1890, there have been reported to the board the following cases of contagious diseases: Diphtheria, 42; deaths, 6. Scarlet-fever, 4; no deaths. Typhoid fever, 10; deaths, 2. Membranous croup, 1; death, 1. Measles, 170; death, 1.

We have caused placards to be put upon all houses in which were such cases of a dangerous character. On account of the unsanitary condition of the premises, from bad water and defective drainage, we have ordered four houses to be vacated, to so remain until their owners should make such changes in the sanitary arrangements as should meet the approval of our board. We have also in many cases discontinued the use of impure well water and caused the houses to be supplied with aqueduct water. We have had a considerable number of petitions and applications to interfere in cases of wet, spongy and malarious land.

Ipswich.

The number of cases of diphtheria reported was six, with one death; of scarlet-fever, 4, no deaths; of typhoid fever, 4, no deaths. With the exception of one case of glanders in a horse, the animal being killed by the order of the board, there have been no cases of disease in animals reported. The regulations of the board were distributed in the spring. After a few weeks a house-to-house sanitary inspection was undertaken in the thickly settled parts of the town. This inspection was repeated when it was thought necessary. This seems to be the only way to ascertain the sanitary condition of the town and how far the regulations have been complied with. Number of notices sent, 125.

Lexington.

The selectmen in their capacity as board of health have been called upon several times during the year to abate nuisances, and in all cases the owners of the premises complained of have readily complied with the requirements of the board, and remedied, for the time at least, the evil complained of. The existence of so

many cesspools, containing as they do all the house drainage, in the most thickly settled portions of the town, is, especially since the introduction of water, a source of danger and a menace to the public health which must at an early day be remedied if we would maintain the reputation of being one of the most healthful towns in the State. There have been less than the usual number of contagious diseases reported to the board during the year, and these have mostly been of a mild type and no fatalities have resulted.

Lynn.

The total number of deaths was 898. The total number of deaths in children under five years of age was 313 as against 361 in 1888. Percentage of deaths under five years to total mortality, 34.9. The largest monthly mortality occurred during the month of August, when the number of deaths was 96; of this number 29 were caused by diarrhœal diseases. There were 132 deaths from zymotic diseases, — 14.7 per cent. of total deaths from all causes. Causes of infectious diseases reported in 1889: Diphtheria, 132; deaths, 26. Scarlet-fever, 69; deaths, 2. Typhoid fever, 58; deaths, 7.

Diphtheria has been less prevalent than in any year since 1886. Only 132 cases have been reported as compared with 248 in 1888 and 172 in 1887. Of these 132 cases 26 died. Membranous croup and diphtheria are considered identical by the board, and whenever a case of membranous croup is reported to the office, as required by an order passed in April, 1888, the same precautions as to isolation of patient and placarding of house are taken as if the case were reported as diphtheria. This action was taken by the board on account of the frequent occurrence of cases of diphtheria in houses and localities which a short time previously contained so-called cases of "croup." Only 7 deaths occurred from typhoid fever as compared with 12 in 1888 and 16 in 1887. There were 58 cases reported against 59 in 1888 and 88 in 1887.

Three thousand one hundred and ninety-six loads were removed from vaults and cesspools during the year, — an increase of 479 over the preceding year. Ten hundred and thirty-two cords of house offal have been collected, being 100 in excess of that collected during 1888. There have been collected 16,977 loads of ashes and waste. The board abolished the rendering works, which for twenty years have been a menace and nuisance to the residents of Ward 3, and particularly to those living in its immediate neighborhood. The firm asked that the order be revoked under promise that the drainage from all the buildings would be connected with the Stacey Brook sewer and no sewage

should enter the meadow. The board did not consider this a full remedy for the abatement of the nuisance, and therefore ordered the enforcement of the order as served. The order was complied with, and the parties ceased rendering and closed the factory.

Malden.

The city to-day stands well in point of health; but, with a growth in the coming few years as compared with the past, no intelligent person can deny that without some system of sewerage Malden must become subject to dangerous diseases.

Number of cases of contagious diseases reported to the board for 1889: diphtheria, 64; scarlet-fever, 55; typhoid fever, 35; measles, 31. Comparative list for 1888: diphtheria, 44; scarlet-fever, 41; typhoid fever, 25; measles, 66.

Maynard.

We have had very few contagious or infectious diseases reported during the year, and there has been no spread of any disease reported. Typhoid fever has prevailed in a limited degree, also a few cases of diphtheria, while outside of these only chicken-pox and influenza have prevailed to any extent. Influenza affected directly 25 per cent. of the inhabitants, while perhaps a larger percentage were affected indirectly.

Medford.

There has been no epidemic of disease other than the influenza, and the rate of mortality has considerably decreased compared with that of 1888. More attention is being given by our citizens to the subject of hygiene than heretofore, but there yet remains much room for improvement. Five hundred and eighty-one nuisances have been investigated by the agents of this board, the most of which have been abated. In the report of the board of health of last year we spoke of the urgent need of a local system of sewerage and drainage, also of the proposed system of metropolitan sewerage designed by the State Board to relieve the cities and towns in the vicinity of the Mystic Valley. Since that time the Legislature has acted favorably in relation to the recommendations of the State Board of Health concerning this important sanitary work, and the commission to supervise its construction has been appointed. Much time must necessarily elapse in the construction of such a vast undertaking; meanwhile the town ought to take action towards the construction of its local system. As it will be necessary to obtain legislative authority to do this,

we believe it would be well to do so without further delay. Possibly by acting promptly a saving may be effected in the cost of excavation, advantage being taken in certain localities of the excavations made for the main or trunk system. Moreover, it will be necessary to carefully consider the best means of meeting this large expense and of funding the debt, all of which will take time. We therefore recommend the appointment of a committee of five or more citizens to take such measures in behalf of the town as may be necessary to place this subject properly before the Legislature, that the authority to raise the funds necessary for the work, together with a commission to supervise it, may be obtained.

Ninety-nine cases of contagious diseases were reported to this board the past year. Of these 25 were measles, 39 were diphtheria, 13 were typhoid fever and 22 were scarlet-fever. There were 6 deaths from these causes, 3 due to diphtheria and 3 to typhoid fever. A comparison of the statistics of this year with those of 1888 will be interesting, as it will be observed that there has been a great reduction in the total number of cases reported, especially typhoid fever.

Number of scarlet-fever cards posted, 22; of diphtheria cards posted, 39; of permits to attend school, 130; of vaccination certificates, 6; of notifications to school board, 57; of premises visited and investigated, 74; of fumigations and disinfection, 76. One hundred and fifty-eight returns of deaths were registered during 1889.

Milford.

Nuisances to the number of over one hundred have been investigated and abated during the year past. They have been generally of small extent, and the orders of this board for abatement have generally been willingly complied with. During the year past contagious and infectious diseases have been very limited in number of cases and of a very mild type in our town generally, but during the last two months, in common with the rest of the world, we have suffered severely from the all-pervading epidemic, influenza. It is a matter of congratulation, however, that the death-rate from this disease and its complications was quite light here compared with most of our neighboring towns and cities.

Nahant.

The town has been favored with another year of complete immunity from contagious disease, not a single case having been reported to the board of health.

Natick.

Two cases of diphtheria have been reported during the year. Deaths from contagious diseases: scarlet-fever, none; typhoid fever, none; measles, none; whooping-cough, 1; diphtheria, 1. The cases of diphtheria above referred to had their origin in a child injudiciously brought here from another town during convalescence from that disease. Whole number of deaths from all causes, including 5 whose remains were brought here from other places, 138. The number of complaints made for the abatement of various nuisances during the year was 131.

Needham.

Contagious diseases reported for the year: scarlet-fever, 20; measles, 2; typhoid fever, 1. There has been no epidemic in the town during the year excepting the present one of influenza, or *la grippe*, which, although not fatal in its character by itself, is nevertheless serious in the amount of sickness and disability which it is occasioning. It is not a disease which can be reached or controlled by public health authorities.

Piggeries are the chief cause of complaints, and the board has labored earnestly with the proprietors, hoping that they would respect the wishes of the public in general, and we feel that in the majority of cases there has been less to complain of than in former years. At the December term of the court the grand jury found an indictment against Henry Bowers for maintaining a piggery nuisance. He was summoned to appear before the court to answer to the complaint, and plead "guilty."

New Bedford.

The keeping of swine is prohibited in the city of New Bedford within certain limits.

May 29, 1889. *Whereas*, the diseases designated as small-pox, scarlet-fever, diphtheria, yellow fever, Asiatic cholera and typhus fever are contagious and dangerous to the public health, and have been and may easily be contracted at funerals from dead bodies or apartments which have been infected by such diseases, it is therefore *Ordered*, That from and after this date no public funeral shall be held over the remains of any person having died of small-pox, scarlet-fever, diphtheria, yellow fever, Asiatic cholera and typhus fever. *Ordered*, further, That the remains of persons dying of either of said diseases shall at once be placed in a tight or sealed coffin, and shall not thereafter be exposed to view or disturbed except for burial. *Ordered*, That all bodies of persons who shall

have died of small-pox, diphtheria, scarlet-fever, yellow fever, Asiatic cholera or typhus fever shall be buried on the same or next day after death; and it shall not be lawful to invite or permit at the funeral, or at any services connected therewith, any person whose attendance is not necessary, or to whom there is danger of contagion thereby. It shall be the duty of every undertaker having notice of the death of any person within the city of New Bedford of small-pox, scarlet-fever, diphtheria, yellow fever, Asiatic cholera or typhus fever, or of bringing of the dead body of any person who has died of any such disease into such city, to give immediate notice thereof to this department. And no undertaker shall retain or expose, or assist in the retention or exposure of, the dead body of any such person, except in a coffin or casket properly sealed; nor shall he allow any such body to be placed in any coffin or casket unless the same be immediately and permanently sealed. Nor shall he assist in the public or church funeral of any such person. *Ordered*, That the body of a person who shall have died of small-pox, scarlet-fever, diphtheria, yellow fever, Asiatic cholera or typhus fever shall not be disinterred for one year after the date of burial.

Number of inspections, 2,390.

North Adams.

Cases reported of contagious diseases for 1888–89: typhoid fever 115, deaths 16; scarlet-fever 28, deaths 0; diphtheria 2, deaths 2. For 1889–90: typhoid fever 30, deaths 5; scarlet-fever 70, deaths 15; diphtheria 7, deaths 5.

Quite a considerable number of cases of typhoid fever occurred in the higher parts of the town, which are so high that they cannot be supplied with water from the town pipes but have to use water from wells or polluted springs. Six cases of typhoid fever occurred last year at one place on East Union Street, and 3 this year. The well water these people used was on analysis found unfit for drinking. It is very important that these high districts should be supplied with pure water as soon as possible. Every privy and every cesspool on streets where sewers are laid should be abolished as soon as possible. We have obtained from the selectmen a list which shows that there are, along the line of public sewers, 364 tenements which are not connected. Only about three-fourths of the houses adjoining the sewers are connected with them, and many of these still have privies and use the sewer connection only to convey off the waste water from sinks; of the others, some of them have privies, some cesspools, and others discharge their sewage into the streets or out upon vacant lots.

North Andover.

There has been an unusual number of cases of diphtheria, scarlet-fever and typhoid fever reported to the board the past year, quite a number of which proved fatal. Numerous complaints have also been made to the board of nuisances caused by uncared-for out-buildings and cesspools, which the board investigated, and notified the owners of the condition of the same, and the nuisances were abated. The board would respectfully recommend that all of the old open privies, which are a constant menace to the health and lives of the people living in the vicinity, be replaced by water-tight vaults.

Northampton.

Nuisances investigated during the year, 210. The infectious diseases reported during the year are as follows: diphtheria, 18; measles, 48; scarlet-fever, 54, — total, 120. The city has fortunately escaped the great increase in the number of cases of some of these diseases, particularly scarlet-fever, that has occurred in most cities and large towns of similar size.

Pittsfield.

The public dumping ground has been properly cared for by covering all filth with soil drawn on the dump for that purpose, and a keeper of the dump has had complete charge, to the satisfaction of the surrounding residents. The total number of inspections made by this board the past year was 543.

Cases of contagious diseases for the year 1889: diphtheria, 43; deaths, 10, or 19 per cent. Scarlet-fever, 99; deaths 14, or 13 per cent. Measles, 26; death, 1, or 4 per cent. Whooping-cough, 7; deaths, 4, or 59 per cent.

It will be noticed that the rate of mortality of the past year is in excess of the previous year. This is easily accounted for, considering the mortality of acute and chronic lung diseases, as well as many other complications following the epidemic of so-called *la grippe*, or influenza. Thousands of cases existed in the corporation, and the death-rate for January greatly exceeded any previous month in the history of this town. The number of deaths in January, 1890, was 54; in January of the year previous, 15.

Provincetown.

During the past year there have been but 2 cases of contagious diseases reported, 1 of which proved fatal.

Quincy.

Three thousand one hundred and twenty inspections were made. Five hundred and forty-six nuisances were discovered, and of these 523 were abated. Every year the demand becomes more pressing for the selection by the city of some place sufficiently isolated where scavengers and others can have a right to dump. The board has received the following returns of infectious diseases: diphtheria, 94; scarlet-fever, 13; measles, 195; typhoid fever, 59.

Salem.

Three hundred and six complaints of nuisances have been investigated. Over 3,200 visits have been made by the different members of the board and the clerk and the inspector. There have been 1,537 loads of night soil and cesspool material collected. The keeping of swine has been discontinued in a number of places since last year. There have been 106 cases of scarlet-fever reported, 21 cases of typhoid fever and 126 cases of diphtheria, with 44 deaths from diphtheria. Inasmuch as diphtheria and membranous croup are so closely allied the board would suggest similar consideration of the latter to that taken and required in undoubted cases of diphtheria. We believe that a measure of relief on the part of physicians would be experienced by this, as more complete isolation of the patient would be effected and more thorough protection to the community afforded. The immediate need of our city is for sewers, and the number of petitions from various portions of our city is the strongest proof that the citizens realize this.

Saugus.

The number of cases of sickness from contagious diseases reported to us from March 11 to January 1 was 17; of this number 9 were from diphtheria and 8 from scarlet-fever.

Sharon.

During the year the board has, as usual, taken whatever steps seemed proper to abate such nuisances as have come to its knowledge. The number requiring attention has not been large. The number of deaths reported for the year is 27. The question of house drainage and the disposal of sewage is an all important one, and it is but a question of time when the necessity for a good system of sewerage will be forcibly felt. In the meantime it is urged that all plumbing be done in the best manner and that cesspools be located at a considerable distance from houses.

Somerville.

Number of nuisances abated, 499 ; referred to the board of 1890, 32 ; complained of, 531 ; number of complaints (many covering more than one nuisance), 229. The number of deaths in the city in 1889 was 598.

Of the diseases classified by this board as dangerous to public health scarlet-fever, diphtheria and typhoid fever are the only ones reported to us during the year. Scarlet-fever has been more prevalent during 1889 than in 1888, there being 123 cases reported in the latter year and 192 cases in the former. It has, however, been of a mild type, 7 cases only terminating fatally as against 15 in 1888. Warning cards are placed on the houses and the premises fumigated after the termination of the disease. A remarkable increase of diphtheria will be noted over the year 1888, there being 130 cases and 28 deaths in 1889 as compared with 75 cases and 21 deaths in 1888. We use warning cards and fumigation in dealing with this disease, the same as with scarlet-fever, and we also have the sanitary condition of the premises investigated. There have been 61 cases and 7 deaths from typhoid fever in 1889 as compared with 63 cases and 17 deaths in 1888, from which it will be seen that the number of cases has not differed materially from last year while the death-rate is considerably less. We examine the sanitary condition of the premises, but do not use a warning card or fumigation.

Springfield.

At the beginning of the year diphtheria was unusually prevalent, and again at its close is increasing. The total number of cases reported was 213. The city death record shows that 61 persons died of diphtheria ; but if we include, as does the State Board of Health, the deaths from croup in our estimate, we find the total to be 89, which is very nearly the true death record of diphtheria. Several causes combine to propagate it in our city. Perhaps the most important factor is the carelessness and ignorance of persons afflicted with mild diphtheria. It is not easy, often impossible, to distinguish between innocent sore throat and the mildest cases of diphtheria. Many adults and some children evidently pass through a diphtheritic attack with little or no prostration, and these "walking cases" may and do spread the disease.

There seems to be no place within a reasonable distance from the city where the garbage can be safely dumped, nor is the plan of composting it for use in fertilizing the soil satisfactory. A proper crematory would not only safely dispose of the offal from houses and markets but could be made to consume dead animals,

infected clothing and other objectionable matter. Such crematories exist in other cities and are becoming more numerous as the years go by. I am convinced that such an apparatus should be put in operation in Springfield in the near future.

Swampscott.

During the past year we have received and investigated all complaints brought to our notice, and have had official notice of 7 cases of contagious diseases: 3 of diphtheria, 1 of measles, 1 of scarlatina, 1 of typhoid fever, and 1 of scarlet rash which proved fatal.

Taunton.

During the year past the board of health has been made an entirely separate department and given the full control of its teams, which hitherto had been furnished under order by the highway department. This has enabled it to do its work more efficiently and more to the comfort of the citizens, with no increase of expense to the city. The city has been districted, and a team now runs daily in the appointed section. The ashes and house-dirt service has greatly increased, and the citizens are now seeking it from all parts of the city.

During the early spring months the diphtheria visited the city quite severely, there having been 19 deaths in 54 reported cases, being more than 35 per cent. The strictest care was taken to prevent the spread of the disease, and no case occurred in which it could be said that it was contracted from any of the infected houses. Different portions of the city were attacked having no immediate relation with each other, and there was no intercourse between the families which suffered most and they were nearly two miles apart. No regularity in the course of the epidemic could be discovered, no possible personal contagion, immediate or mediate, except in two families. The epidemic of typhoid fever, which seemed to have its maximum in August and September, though widely spread, was of a mild character and caused only 6 deaths. But not a single death has been registered from scarlet-fever, though it has been more or less prevalent during the year, the month of September being the only one in which no cases were reported.

Ware.

There were reported by the local physicians 13 cases of diphtheria, 3 cases of scarlet-fever and 4 cases of typhoid fever. Most of the cases of diphtheria reported occurred in the out districts of the town, where little attention is given among the house owners to proper sanitary conditions.

Watertown.

The town has been unusually free from contagious diseases during the past year. Twenty-five cases in all have been reported as against 29 last year. As heretofore all cases are at once reported to the superintendent of schools and the librarian of the public library. Number of cases reported : diphtheria, 15 ; scarlet-fever, 3 ; typhoid fever, 5 ; cholera infantum, 2, — total, 25. In all 63 complaints have been investigated in various parts of the town.

Wellesley.

Number of contagious diseases reported to the board 14, as follows : diphtheria, 1 ; scarlet-fever and scarlatina, 2 ; measles, 4 ; typhoid fever, 7. Whole number of deaths, 44.

Weston.

Only 4 cases of diphtheria have been reported to the board, with 1 death ; 2 cases of typhoid fever, both of which recovered. A mild type of measles has prevailed in District No. 6. The above covers a period from April 1, 1889, to March 1, 1890.

Whitman.

The resident physicians have reported the following number of contagious diseases: whooping-cough 20, measles 16, typhoid fever 15, scarlet-fever 10, diphtheria 6, mumps 6. There have also been reported nearly 300 cases of *la grippe* in our town.

Woburn.

During the year the board has served by its agent 9 notices on persons to abate nuisances on their premises, principally for the flow of sink-water on the surface of the ground ; all of which were abated without further trouble. Piggeries also constitute another nuisance, and the board finds it a very difficult matter to control. On Aug. 15, 1889, the board held a meeting, when it was decided to reduce the nuisance to a minimum, and it was voted to recommend that the keeping of swine in the city be regulated by a city ordinance, making it necessary that swine shall not be kept except by a license to be granted by the board of aldermen. Much of the work of the board has been done by a quiet request to the parties to abate the nuisance complained of, and in most instances there was no necessity for further action. It has been the policy of the board to accomplish in a quiet way the abatement of an existing nuisance without having recourse to legal action. During the year 1889 physicians have reported 68 cases of typhoid fever, 13 of scarlet-fever and 23 of diphtheria.

Worcester.

Number of cases of contagious and infectious diseases: Diphtheria, 185; deaths, 33, or 17.84 per cent. Scarlet-fever, 81; no deaths. Typhoid fever, 127; deaths, 25, or 19.69 per cent. Measles, 1,083; deaths, 20, or 1.85 per cent.

Number of complaints for the year ending Dec. 30, 1889, 1,009; average number of visits made, 3,—making a total of 3,027. The subject of disposing of the garbage is now receiving a great deal of attention from sanitarians all over the country, and they seem to be unanimous in favor of a change from methods existing here in New England. The systems that sanitarians most favor are the Merz Extractor, in operation at Buffalo, and the several furnaces that entirely destroy the garbage by fire. The Merz system employs heat and chemicals to extract the grease, and leaves a residue that is sold as a fertilizer. The other system, of which the Mann, Ryder and Engle are the most favorably mentioned, consumes the garbage completely. Each of these systems has its advocates and much is said in favor of both. The system of cremation has this advantage not possessed by the other: it can be used for destroying infected bedding, furniture, dead animals, fish offal (a great cause of offence at present), lobster, clam and oyster shells (which are not taken at present). The fish offal mentioned above is now collected by the city and, after carting to the city farm, is buried, but is often disinterred by wild animals and dogs. Now, your board is at present inclined to the opinion that the cremation system is the best for this city, but it has not had the means to investigate these systems thoroughly, and consequently it has no decided opinion to offer on their respective merits. One thing is certain, however; either system is far superior from a sanitary stand-point to the one at present in use here; and if it is true, as is claimed for them both, that they can be centrally located without giving reasonable cause for complaint, they have the further and by no means small advantage over the present system of shortening the haul which our swill-loaded teams are now obliged to make through the streets of the city. Thorough investigation by this board, if you so determine, or by a committee selected from your own body, can only determine which, if either, of these systems is the better for Worcester.

INDEX.

INDEX.